Spring 2019

Dundon Berchtold Hall (Academic Building Design)

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UNIVERSITY OF PORTLAND
Donald P. Shiley School of Engineering
CIVIL ENGINEERING PROGRAM

CE 484 Senior Design Project II
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Written Report

Project: Dundon Berchtold Hall (Academic Building Design), Portland, OR

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April 2019

Letter of Transmittal

April 26, 2019

University of Portland
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Portland, OR 97203

To whom it may concern,

We are writing to you with the project report titled "Dundon Berchtold Hall (Academic Building Design)". The purpose of writing this report is to present the structural design as completed by the senior design capstone group consisting of members Leily Mojarab, Kyle Cadiz, Sofia Martinez, and John Black. This project officially started in the Fall 2018 semester at the University of Portland, and was completed in the Spring 2019 semester. The faculty sponsors for this project included Dr. Mehmet Inan and Dr. Matthew Kuhn. The industrial sponsors for this project included Mr. Aaron Wegner of KPFF, Mr. Andrew Burke of Soderstrom Architects, and Mr. Kevin Kelly of Fortis Construction.

This report consists of the full research and design work completed by this group through the Fall and Spring semester at the University of Portland. This includes a background of the project, the design approach, and the design process. Included in the appendices are calculations, drawings, memorandums, and additional information relevant to this project. This is submitted as a final copy of this written report.

We fervently hope you find this report worth reading. Please feel free for any query or clarification you would like for us to explain. We hope you will appreciate the hard work put into this report and project as a whole for the past year.

The interest and consideration you are demonstrating on behalf of the Dundon-Berchtold Hall senior design group is acknowledged and greatly appreciated.

Sincerely,

Leily Mojarab   Kyle Cadiz   Sofia Martinez   John Black

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SECTION 1: INTRODUCTION

The Dundon-Berchtold Hall Structural Design project is a currently existing, ongoing construction site located at 5000 North Willamette Boulevard in Portland, Oregon. This building will operate as an academic building with classrooms and faculty offices. The scope of work for this project is to select a building system, create a structural layout, design structural members, produce plans, and produce a calculations package. The design team's goals of this project are to design a structural frame for the future Dundon-Berchtold academic building on the University of Portland campus and ensure the design fits the architect's needs in the most feasible way possible. The team shall develop a final structural design for the frame of the Dundon-Berchtold academic building, providing construction drawings as well as a virtual structural model. The purpose of this report is to provide an analysis of how this project was completed. This report addresses a background of the project, the team's evaluation of alternative design options, and describe the design work completed; respectively. It will also include an appendix with calculations, progress memorandums, teamwork evaluations, aspects of the project which required independent research and learning, modern engineering tools, and a descriptive table of codes and standards the team utilized to complete this project.

SECTION 2: BACKGROUND

2.1 History

In the late spring of 2018, the University of Portland began the demolition of Howard Hall. Howard Hall was built in 1927 and served as a recreation center with a gymnasium-auditorium, a large tile swimming pool, and regulation basketball court with a stage[1]. The building currently under construction where Howard Hall once stood is Dundon-Berchtold Hall. This building will provide 63,000 square feet of academic space including classrooms, faculty offices, an auditorium, career center, and the Dundon-Berchtold Institute for Moral Formation and Applied Ethics[2]. The budget for this project is $36 million with $15 million committed from Board of Regents member Amy Dundon-Berchtold and Jim Berchtold from the class of 1963[3]. After an interview with the stakeholder, it was evident that this project was a necessity because the student population of the University has grown 30% over the past decade with no increased classroom spaces. Currently classroom space is occupied at 94% in the University's "off hours", that is from the hours of 4:00 P.M. to 10:00 P.M. Typically, universities aim for 64% occupancy during their "off hours". As late classes can affect campus life for students as well as faculty, it was important for the University to offer more classroom space. This allows for more classes to be held during the business hours and reduces the need for later classes. Though the design for this building has been completed and the construction is underway, the project team will work to develop their own analysis and design for the structural framework of Dundon-Berchtold Hall. A

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1 "Home." Environmental Science and Theology in Dialogue August 02, 2018 https://sites.up.edu/upbeat/howard-hall-1927-2017/

2 "News." Freshman Checklist and Timeline | University of Portland https://www.up.edu/news/2017/02/dundon-berchtold-hall-announcement.html

3 Ibid

vicinity map provided by the geotechnical engineers for this project, Geotechnical Resources Inc. (GRI), can be found in figure 2-1. Figure 2-2 shows the site in relation to surrounding buildings on the University campus.

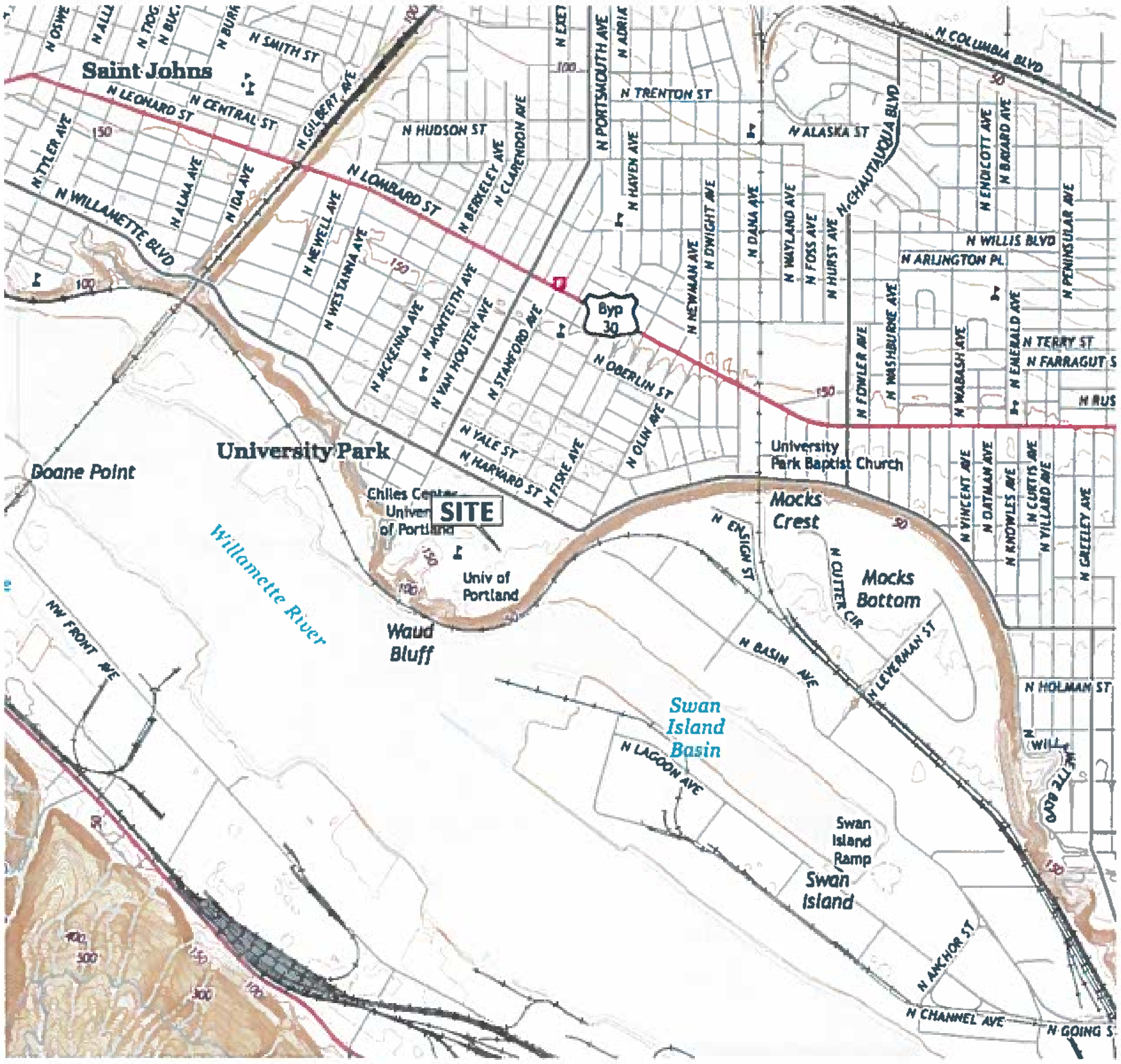

Figure 2-1. Vicinity Map for Dundon-Berchtold Academic Hall

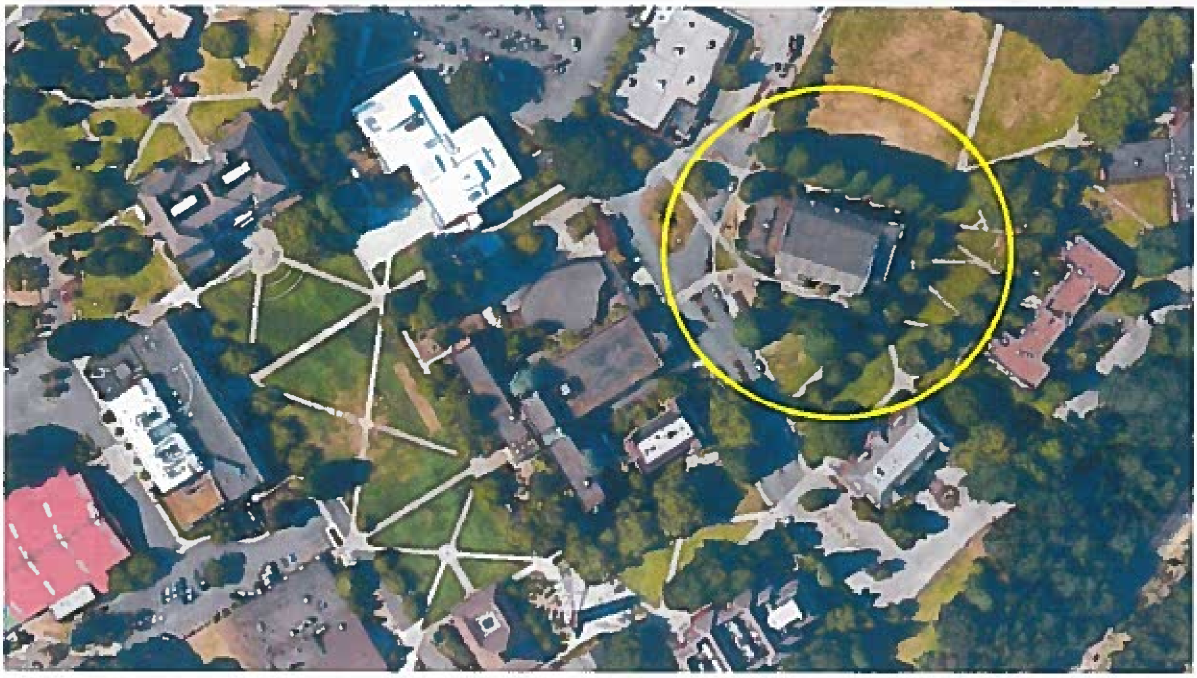

Figure 2-2. Site in Relation to Surrounding Buildings

2.2 Original Condition

Based on the Geotechnical Report provided by GRI, the project team determined the original conditions of the project site. The original condition consists of a relatively flat site ranging from 168 feet to 174 feet of elevation. Five boring tests were done to determine the types of soil underneath the project site. From these boring tests, sandy silt and sand were found. It is important to note that some of the soil found in the first few feet from the surface are likely from backfill from other projects rather than native soil. Generally, excavations for buildings and projects on campus have used local soils to backfill which may be the case in the top layer of soil at the project site. Each of the boring tests conducted by GRI were terminated in sand less than 50 feet from the surface. No groundwater was found in any of the borings. A copy of GRI's

report for each boring can be found in appendix G. Combined with the general knowledge in the area of groundwater being contacted further than 50 feet down, GRI suggests that the site is suitable to dispose storm water on site. Additionally, under the assumption that the 2014 Oregon Structural Specialty Code is to be followed during design and construction of the academic building, GRI conducted a study of the area and potential seismic threats. While considering a potentially large earthquake from the Cascadia Subduction Zone, subcrustal earthquakes, local crustal earthquakes, and site liquefaction, GRI gave the project site a seismic site class D. The seismic class means the site has a high seismic vulnerability and determines the seismic codes that the structural engineer must adhere to. This is to be considered in the design work of the building from a structural standpoint.

2.3 Jurisdictional Aspects

In order for the University of Portland to construct a new academic building, permits for construction and inspection are required from the city of Portland, Oregon. Permits and inspections are required for the city to ensure that the design and construction of new buildings are following the required codes and standards as per the law. To start this process, the University reaches out to a City Process Manager[4]. The City Process Manager assists the client, in this case the University of Portland, from the early stages of design on to the construction of the building. This provides redundancy for the city of Portland to oversee the compliance of the law for any new buildings or modifications to structures within the city. The Process Manager also assists in the explanation and communication of the law and regulations to ensure the stakeholders and design team are aware of any constraints or potential conflict points. For the

4 "Process Management." Development Services. https://www.portlandoregon.gov/bds/48323

size and cost of Dundon-Berchtold Hall, it is classified as a large project. Upon approval for construction, the process manager keeps in contact with the client to communicate inspections and address any potential issues during construction. This will restrict the design team to conform to the city's standards and limitations.

2.4 Regulatory Aspects

Another important aspect for the design team to consider are all the jurisdictional laws and codes they will have to follow in order to make a feasible and safe design for the Dundon-Berchtold Hall. Since the university is in Portland City's jurisdiction, then it is subject to the codes and laws set forth by the City of Portland. According to the City of Portland Oregon's website, the codes that must be followed in the development and construction of this facility include the Oregon Structural Specialty Code (2014 Edition) as an extension to the International Building Code (2012 Edition) and it is overseen by the Building Codes Division of the Oregon Department of Consumer and Business Services[5]. Another set of codes to be followed include the National Fire Code set forth by the National Fire Protection Agency[6]. These codes restrict the team's design to adhere to the regulations required. A list of codes can be found in Appendix A, Table A-2.

2.5 Environmental and Sustainability Aspects

Something which the design team will need to consider is the environmental impact of the building design. This is the impact the building itself has on the environment. The design team

5 "24 10 040 Codes." Title 24 Building Regulations, January 31, 2018, https://www.portlandoregon.gov/citycode/article/671398

6 "List of NFPA Codes & Standards." *NFPA Reports - Fires in the United States*, www.nfpa.org/Codes-and-Standards/All-Codes-and-Standards/List-of-Codes-and-Standards

will need to establish natural resources that will be displaced, the effects on wildlife, the influx of people that will be brought in to this area, and how this influx will this affect the environment. This task is often done more by an environmental engineer. However, for the purpose of this project, the design team will evaluate the impact that construction, a new building, and new students will have on the environment.

One of the ways in which to rate a building's sustainability is by the Envision Rating System. Envision measures the sustainability of an infrastructure project from design through construction and maintenance. It can be used by infrastructure owners, design teams, community groups, environmental organizations, constructors, regulators, and policy makers in order to meet sustainability goals and gain public recognition for sustainable achievement[7]. If this building is rated well by Envision standards, it is also more likely to attract students to the University. A well rated design is an attainable goal by the design team and will be on the forefront of their design as the stakeholder has made known their hopes for this certification. In order to do this, they will need to consider the materials they choose for their design and their effect on the environment and on human health. For the purpose of this project, this design team performed an Envision Rating Analysis after their design in order to determine how their design will rate in terms of sustainability. This aspect guided the team's design to consider the environmental impacts and sustainability of the materials they choose and the logistics of the design.

7 "Envision." American Society of Civil Engineers (ASCE). https://www.asce.org/envision/.

After applying the design to the Envision Rating System, the project team achieved a rating of "Improved". This describes a design that is at or above conventional sustainability standards. A summary of the Envision scorecard for this project may be found in Appendix G.

2.6 Stakeholders and Their Needs

The University of Portland serves as the stakeholder for this project, with Father Mark Poorman as the President of the University being the figurehead for the stakeholder. The design team met with Father Poorman to interview him about the needs for this building from the stakeholder's view. His needs for the building are aesthetically, functionally, and economically based. The building should be architecturally beautiful, ideally with a traditional collegiate gothic design. It should be a statement building, but not domineering, that will attract prospective students to the University. The building should also be functional as an academic building. There should be many classrooms with advanced learning technology to aid the new generation of future alumni. These classrooms should also have movable furniture to create an interactive learning space. With this movable furniture, storage will also need to be provided. Additionally, there should be room for faculty offices and an auditorium. With a $36 million budget, the University is aiming to get as many classrooms and faculty offices that it can without going over budget. This is an unusual approach because there was not a defined required number of classrooms and offices. If possible, the University also hopes to achieve LEED Certification, adding a sustainability factor into the design. Because of the stakeholder's aesthetic needs for the building, this limited the design team to conform their design to the architect's desires for the building. These aspects restricted a certain amount of creative freedom with the project due to the need to satisfy what

the architect wants in order to please the stakeholder. Figure 2-3 shows the architectural rendering accepted by the stakeholder. All architectural renderings were provided by Soderstrom Architects. Figure 2-4 shows the structural rendering for this same view. The project team has provided it to compare against the architectural. All structural renderings were provided by KPFF.

Figure 2-3. Architectural Rendering of the Signature Building Accepted by the Stakeholder

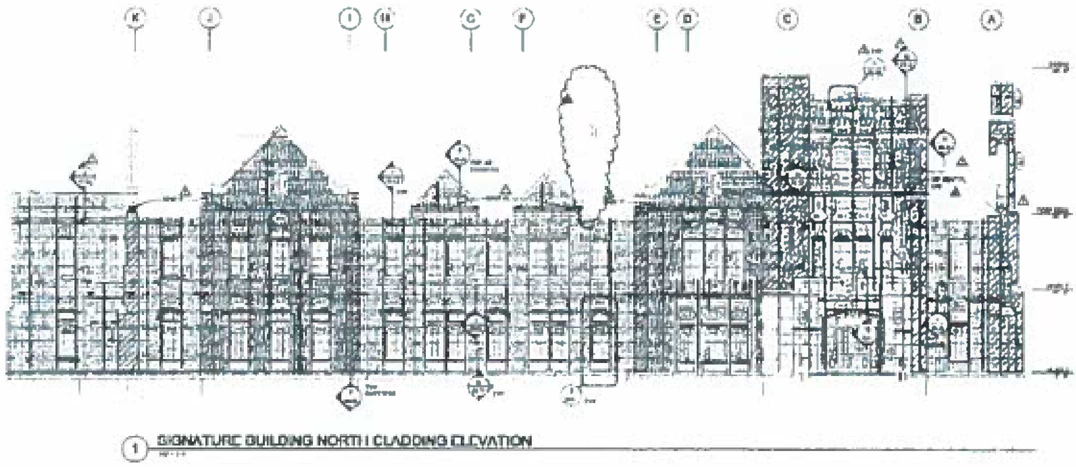

Figure 2-4. Structural Rendering of the Signature Building

2.7 Political Aspects

The Dundon-Berchtold academic building is set to house the Moral Formation and Applied Ethics department. From a political perspective, this building on campus is vital to the ability to educate all students and foster an environment of diversity and political awareness. The University of Portland is no stranger to its student body being active regarding modern political issues and to incorporate a new headquarters for the ethics department, along with more classrooms and offices, is positive step in achieving the primary goals of the University. This building directly impacts all current and future students plus faculty in the way the University is able to grow and reach a wider audience of people seeking to further educate themselves and share ideas. The political aspect of the location and its people cannot be overlooked when considering the growth and development of the community as the University of Portland is doing with Dundon-Berchtold. While this aspect does not necessarily guide the design itself, it is an

important feature that the design team must consider in order to better serve the stakeholder's needs.

2.8 Societal Aspects

Being a special building for the University of Portland, the Dundon-Berchtold Hall could come with some major societal impacts. The primary impact the team hopes for in this project is to attract prospective students to a great community for them to learn and develop into professionals who will take what they have learned and make their own societies, not limited to just Portland or any subcommunities, better for themselves and their peers. The team hopes to attract a diverse group of students for the many decades to come and to show them that the work they will be doing at the University of Portland will be important because they will be important. The team will be designing while keeping in mind the needs and rights of all those who may attend or visit the University of Portland's Dundon-Berchtold Hall in the future in order for it to become a place where all feel welcome and equally important.

2.9 Public Health, Safety, and Welfare

As this team considers the factors involved in designing an academic building on their own campus in Portland, Oregon, they must also consider the public health, safety, and welfare. One of the biggest threats to the public in terms of this structural design, are seismic factors that may damage the building and pose as a risk to the public. When planning for earthquakes in building design, there are multiple components of the building that can be specifically selected to aid the building in absorbing energy. Firstly, the foundation can be tied to the rest of the building

since earthquakes usually knock a building from its foundation. A ductile material can be chosen instead of a brittle one such as steel or wood instead of brick and mortar[8]. Another option is to have shock absorbers in the foundation such as ball bearings or padding. Finally, redundancies can be planned and installed so that if connections fail, the next connections will lead loads down designed load paths to dissipate the concentrations of loads, avoiding collapse[9].

The team examined this issue by looking at Kathmandu University, another academic institution at risk for seismic activity and the threats to its public health, safety, and welfare thay may result. The nation of Nepal and more specifically the city of Kathmandu are at risk of intense earthquakes. Civil engineers in Nepal must take into consideration seismic loads when designing new structures. In April of 2015, Nepal was hit by a 7.8 earthquake which killed nearly 9,000 people. Researchers say the pressure under the tectonic plates was not entirely dispersed and while that means the earthquake wasn't as big as it could have been, it means that there could be another one sooner. Along with resultant avalanches and aftershocks, this earthquake was extremely deadly and damaging. 3.5 million people were left homeless including entire flattened villages[10]. Nepal is one of the poorest countries in Asia and can do little to build up its own infrastructure. As a result, much of the earthquake damage still exists because it would cost $5 billion which is 20% of Nepal's GDP. Kathmandu University was in one of the most affected areas by the earthquake[11]. The school buildings suffered some deep cracking that

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8 Thomas. "Earthquake-Resistant Building Materials for Seismically Sound Structures." Thomasnet Industrial Marketing & Sales Blog. http://blog.thomasnet.com/earthquake-resistant-building-materials.

9 Harris, William. "How Earthquake-resistant Buildings Work." HowStuffWorks Science. June 28, 2018. http://science.howstuffworks.com/engineering/structural/earthquake-resistant-buildings4.html.

10 "2015 Nepal Earthquake: Facts, FAQs, and How to Help." World Vision. September 14, 2018. https://www.worldvision.org/disaster-relief-news-stories/2015-nepal-earthquake-facts.

11 Ibid, 2018

was repaired in about a month. Students and staff were away on holiday during the time of the earthquake, so the campus did not suffer any casualties. However, students were still left in disarray and in fear of the building's collapse. The university plays a large role in rallying students, faculty, stakeholders, and other communities to aid in rescue, relief, and recovery during the aftermath of the earthquake.

Seismic activity is one that affects the health, safety, and welfare of much of the world. Figure 2-5 shows the risk of global seismic hazards. These hazards include landslides, ground shaking, liquefaction, surface rupture, tsunamis, flooding, and fire[12]. The Pacific Northwest lies on the Cascadia fault-line and is at risk of devastating earthquakes[13]. Much like Kathmandu University is important to its students and the surrounding community, the University of Portland is important to its students and community. Therefore, the design team will need to incorporate seismic design as one of the most important factors in their structural design. As a result of these factors, the team is guided in their design to give greater value to seismic loads, leaving room in their design for seismic resistance elements. The current structural design implements Buckling Restrained Braces as a method to allow the building to withstand cyclical lateral loadings as a result of seismic activity. The structural drawing for these braces can be found in figure 2-6.

12 "Earthquake Hazards Overview" Pacific Northwest Seismic Network http://pnsn.org outreach/earthquakehazards.

13 Schulz, Kathryn "The Earthquake That Will Devastate the Pacific Northwest." The New Yorker November 16, 2018 https://www.newyorker.com/magazine/2015/07/20/the-really-big-one

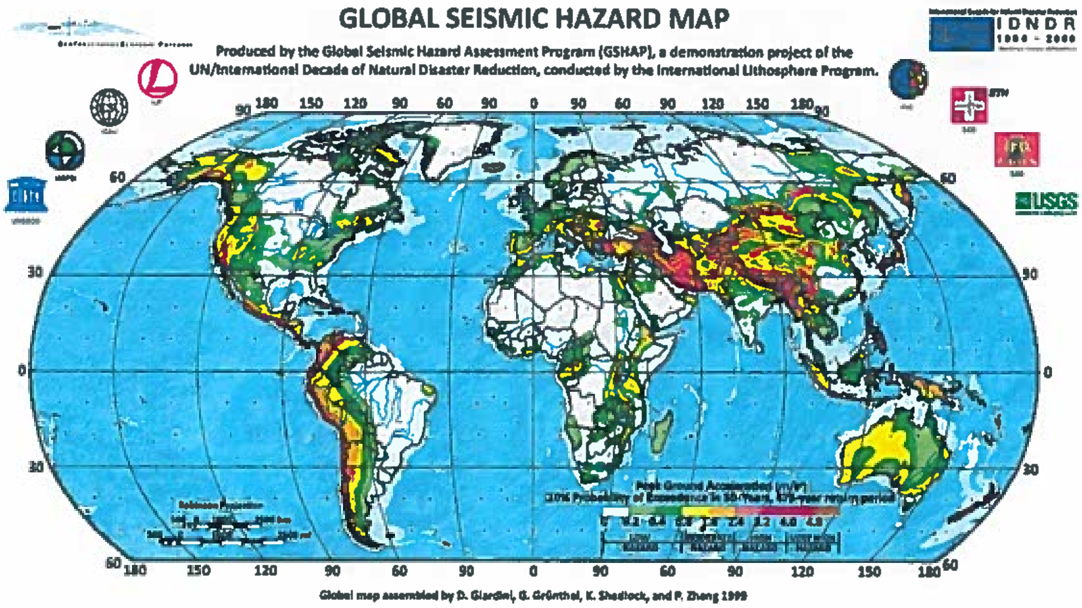

Figure 2-5. Global Seismic Hazards Map[14]

14 Leahy, P Patrick "Natural Hazards Identification and Hazard Management Systems." Oxford Research Encyclopedia of Natural Hazard Science. May 16, 2018 http://oxfordre.com/naturalhazardscience/view/10.1093/acrefore/9780199389407.001.0001/acrefore-9780199389407-e-167

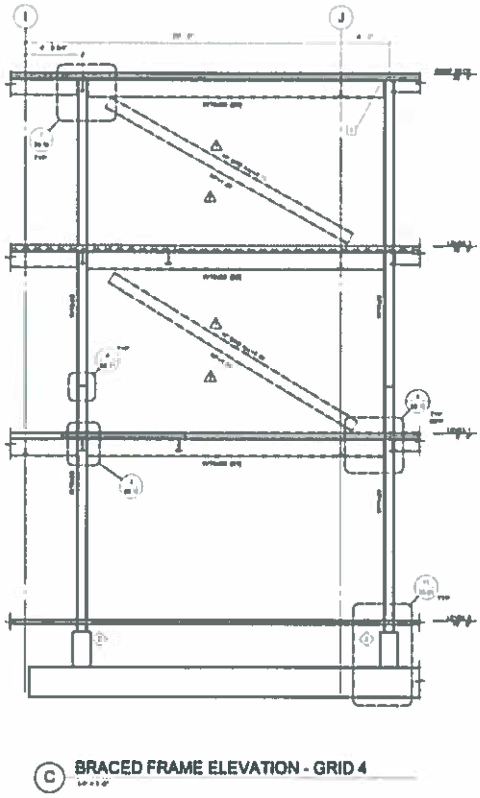

Figure 2-6: Buckling Restrained Brace from the existing structural framing plans for Dundon-Berchtold Hall

2.10 Constructability Aspects

The most important consideration that must be made by the design team is determining whether the design can be implemented. Constructability is a best practice that must be taken into consideration during the planning, designing, procurement, and field operation phases of an entire project. The success of a project, at its core, is based on the constructability of the project. The purpose of considering constructability is to make sure that the entire structure can be built successfully before the construction begins.

In order to be successful in designing a structure that is constructible, the design team must use every resource at their disposal. Various resources that can assist the design team during the design process are: structural analysis software, handwritten structural analysis calculations, computer aided design (CAD) software, building information modeling (BIM) software, building construction information, and building construction experience-based knowledge. These resources can be used to solve design issues before the project is even put to a bid. It is important to utilize these resources and determine all design issues whether they may be a beam unable to support a load or an HVAC duct clashing with a water pipe. All these issues should be discovered and fixed before construction. Making a project constructible before the construction process ultimately saves money and can reduce time.

Another consideration the design team should account for in terms of constructability is the actual construction operation constraints. Certain aspects of the design can lead to issues in construction that can be avoided. For example, for some structures being built on smaller sites, it may be more feasible to utilize steel as the primary structural material instead of concrete because steel can be erected with minimal tools and crews. Steel would only need a crane and erection crew and would not need any pre-installation work. Concrete on the other hand would first require formwork to be constructed and rebar to be placed weeks before a pour. If using concrete, easy access for concrete trucks must be determined for batch deliveries and trucks must be spaced evenly so as to not lose money to mix expirations. Finally, a pump truck and a large crew is needed to place and finish the concrete in a timely manner. Smaller construction sites

cannot accommodate mass structural concrete placements and thus lead to the determination that steel would be better. For this project specifically, the design team must take into consideration the construction site constraints. The site is located in the middle of a university campus with relatively sufficient access (since the site is near the entrance) but the campus experiences large volumes of vehicular and pedestrian traffic. The size of the site itself is limited in order to give the university enough space to conduct daily operations. All these constraints were considered when designing the academic building.

2.11 Economic Aspects

Concern about constructability then leads to concern about overall cost. Perhaps the second most important aspect of a building, after making it buildable, is the capital cost. Modern day construction projects cost millions and sometimes billions of dollars to build. This makes finding cheaper building methods and materials very important. The two alternatives for structural materials that the design team must choose from are reinforced concrete and steel. The price of the academic building is not of concern to the design team, only the stakeholder. However, it is still important for the design team to avoid choosing extremely expensive materials. Currently concrete costs on average about $108 per cubic yard[15] and a single steel beam can cost thousands of dollars[16]. The prices of these two structural materials are not to be taken lightly in the design phase because they have the potential to have the greatest influence on cost, which can essentially determine whether the project will proceed.

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15 Concrete Network. "Concrete Prices - How Much Does Concrete Cost?" The Concrete Network. September 21, 2018. https://www.concretenetwork.com/concrete-prices.html

16 "Cost to Install Steel Beams." 2018 Cost To Tile A Shower | How Much To Tile A Shower https://www.improvenet.com/r/costs-and-prices/steel-beam-installation-cost-estimator

SECTION 3: DESIGN APPROACH

The project team developed a design for the structural frame of the Dundon-Berchtold academic building. This entails conceptual design, initial design with sketches, construction drawings, feasibility analysis, cost analysis, and a final design with drawings. A detailed copy of the project team's scope of work can be found in Appendix G.

The conceptual design includes an analysis of the function and form of the building given the architectural design and the stakeholder desires. The team has received the architectural plans for review to help guide the design to meet the needs of the architectural firm. Since the architectural firm won the bid for this project, the role of the project team as structural engineers is to match the intended design and make changes as requested by the architects. For Dundon-Berchtold, the architectural design adheres to the stakeholder's desire to make a standout building that will be the premier building on campus. Part of this includes the makeup of the exterior of the building, using masonry, and encompassing a collegiate gothic style of roofing.

The design and building process will influence the final design and was discussed and reviewed by the project team. This includes considering the priorities of the building and the feasibility of potential designs. An initial design will be provided including initial sketches accompanied by supporting calculations. A further detailed structural model will be provided using Revit that will be load tested to exemplify structural soundness of the design. To perform load analysis, the project team will use the RISA program. The virtual structural model will include the structural

framework and contract drawings of the Dundon-Berchtold academic building. The project team will also consider the feasibility of their design which includes a rough and final cost estimation, the constructability, and the environmental impact of the specific design and the project.

To start the design process, the project team first had to analyze their area of responsibility for this project. As mentioned in the scope of work, the project team is responsible for designing the structural framing of the building to fit the architectural designs. An initial analysis must be performed on the different materials that could be used in constructing the framework which is imperative to the overall design. Materials considered for this building include wood, concrete, and steel.

As a structural material, wood is best utilized on smaller projects. Wood is primarily used as a structural material in residential development due to the smaller loads it can handle in homes. There are not many commercial buildings that use wood in its structural framework. That however does not discount the benefits wood has as a structural material. Wood is lighter by volume than both concrete and steel and is easy to shape. Wood amounts to concrete in compressive strength, making it a viable option for many projects[17]. It is also a very useful material in terms of the environmental impact of its manufacturing. Less water is needed to treat wood and the overall production emits less greenhouse gases than concrete or steel. This does come with the responsibility of sustainable forest management to prevent overuse of resources. Another drawback from wood, because of its rarity in structural framework, is that there aren't as

17 "Choosing between Wood Concrete and Steel Structures." Material Choices for Wood Frame Construction - Ecohome
https://www.ecohome.net/guides/1010/how-wood-structures-compare-to-steel-and-concrete/

many regulations as concrete or steel. This makes the design process difficult in terms of lack of guidance[18].

Concrete is a more common structural material that is normally incorporated with steel rebar. Concrete has many benefits as a structural material. In terms of its strength, concrete has high wind resistance, which is useful in taller structures, and it is a ductile material, making it good for seismic resistance[19]. This project is being implemented in the Pacific Northwest, so seismic resistance is a very important issue to consider in structural design. Concrete can be shaped into anything using proper formwork technique, this is very beneficial for buildings that are meant to be more artistic in architecture. In terms of economy, concrete has a good investment return and saves money in other areas of construction and operation. Unlike steel and wood, concrete does not require additional fireproofing, saving a lot of money in the construction process. Additionally, insurance companies recognize the effectiveness of concrete as a structural material and don't implement high premiums as a result. The overall operation cost of the building is reduced by these insurance savings[20]. As far as environmental impact is concerned, concrete structures are typically recycled to be re used in other projects. The aggregates in concrete are normally recycled and used in road construction and the rebar is recycled for future steel use.

The drawbacks of concrete mainly lie in its price and supply. Concrete is an expensive material that costs about $108 per cubic yard[21]. Not included in this cost is the price of wood for

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18 Ibid

19 "Which Is the Better Building Material? Concrete or Steel?" Facility Management and Commercial Building Resource https://www.buildings.com/news/industry-news/articleid/2511/title/which-is-the-better-building-material-concrete-or-steel-

20 Ibid

21 Concrete Network "Concrete Prices - How Much Does Concrete Cost?" The Concrete Network September 21, 2018 https://www.concretenetwork.com/concrete-prices.html

formwork, rebar for reinforcement, and man hours for placement. Moreover, along with steel, the cost of concrete is rising. The higher cost of concrete is also a consequence of limited cement suppliers. This type of concrete ingredient is not produced in the U.S. as much as it is in other countries, this requires concrete suppliers to import cement, therefore driving up the overall cost of concrete[22]. Unless more U.S. manufacturers produce more cement, the capital cost of concrete can be expected to rise.

Steel is another common structural material known for having the highest strength to weight ratio of all structural materials. This means that a smaller amount of steel still has very high strength. This decreases dead loads of buildings and saves building space in the design process[23]. Similar to concrete, steel has high wind tolerance, making it ideal for taller structures, and it is strong and ductile enough to be an ideal material in seismic regions such as the Pacific Northwest. Steel allows for the design of larger open spaces in buildings by using longer beams and taller columns, this is beneficial in designs where utilizing as much space as possible is needed[24]. In terms of cost, a single steel beam can cost upwards of $1,000[25], this is a high cost but is relatively appropriate due to the need for less additional materials and work. Like concrete, the price of steel is rising. It is much easier to build with than concrete because it only requires an erection crew and welders. Regarding environmental impact, steel is a sustainable material. 85% of steel

22 "Which Is the Better Building Material? Concrete or Steel?" Facility Management and Commercial Building Resource https://www.buildings.com/news/industry-news/articleid/2511/title/which-is-the-better-building-material-concrete-or-steel-

23 Ibid

24 Ibid

25 "Cost to Install Steel Beams " 2018 Cost To Tile A Shower | How Much To Tile A Shower https://www.improvenet.com/r/costs-and-prices/steel-beam-installation-cost-estimator

is recycled and re-cast into steel used for other projects. Moreover, the process of producing recycled steel uses 1/3 less energy than producing new steel[26].

The drawbacks of steel lie mainly in cost. Steel is the most expensive of all structural materials. Another drawback is that steel is not fireproof, which leads to the requirement of fireproofing during the construction process, this drives up the cost of construction[27]. Steel is also normally manufactured far from typical construction sites, thus increasing the transportation cost to the site[28].

Following a selection of the material for the building is the adhering to specific constraints from the architect. Due to the nature of the classrooms and auditorium, specific spans of rooms must be met as a minimum. Figures 3-1 and 3-2 provide a comparison between the structural and architectural renderings for one of these auditoriums to illustrate the importance of these necessary room spans. The difference in these renderings show the importance of keeping in mind the architectural needs for this project. These areas of conflict are what the project team will first focus on in their design. There are several important areas that must be considered during the design process, which include placement of bracings or shear walls, connections between the signature and classroom wings of the building, and beam connections. These areas of interest are among the first to be designed and have a large impact on the overall design.

26 "Which Is the Better Building Material? Concrete or Steel?" Facility Management and Commercial Building Resource https://www.buildings.com/news/industry-news/articleid/2511/title/which-is-the-better-building-material-concrete-or-steel-

27 Ibid

28 Ibid

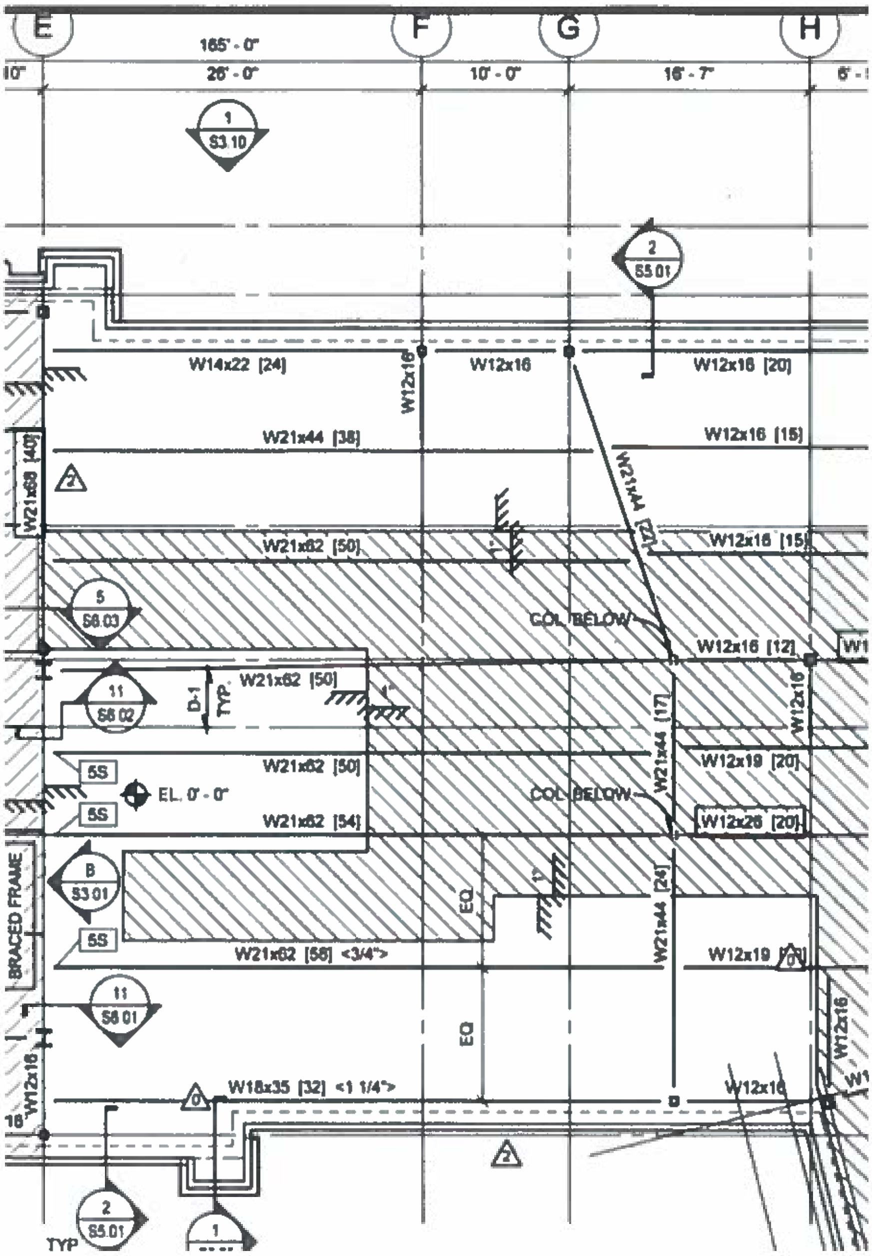


Figure 3-1. Structural Rendering of Basement Auditorium

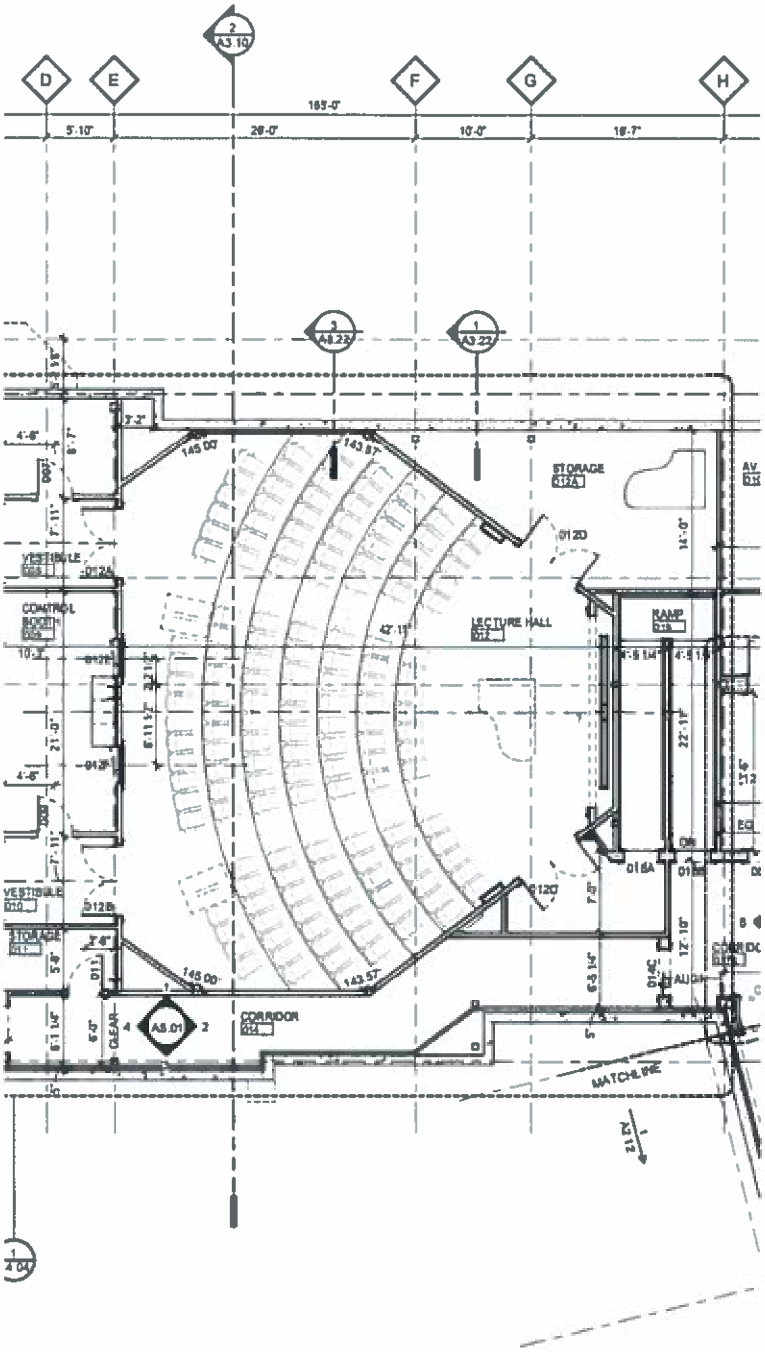


Figure 3-2. Architectural Rendering of Basement Auditorium

A design matrix summarizing and quantifying the advantages and disadvantages of each alternative can be found in table 3-1. This matrix uses criteria such as structural qualities, constructability, economics, environmental impact, and stakeholder benefit to evaluate each alternative. Based upon the quantitative analysis of each alternative, the project team can conclude that steel is the most efficient material for this project.

Table 3-1. Design Matrix Comparing Each Material Alternative

	Wood	**Concrete**	**Steel**
Structural Qualities (25)	15	20	25
Constructability (25)	0	22	23
Economics (20)	20	16	12
Environmental Impact (10)	8	6	6
Stakeholder Benefit (20)	0	15	20
Total (100)	**43**	**79**	**86**

Following this choice of building system, the team has completed a structural design of Dundon-Berchtold Hall. For the sake of brevity and a focus on the educational aspect of this project, the project team focused their design on particularly interesting areas of the building. As this is the final installment of this project report, a tentative weekly schedule for the remainder of the spring 2019 semester has not been provided. There is however a weekly schedule outlining

the chronological approach of this design that may be found in table 3-2. A detailed tentative weekly schedule used for the spring 2019 semester, built in Microsoft Project can be found in Appendix G.

Table 3-2. Weekly Schedule of the Chronological Approach to the Design

Week	Task
13-January	Begin preliminary structural layout
20-January	Begin calculating dead and live loads
27-January	Continue dead and live load calculations
3-February	Complete dead and live load calculations
10-February	Choose decking, begin tributary areas for preliminary structural layout
17-February	Complete tributary areas for preliminary structural layout, begin beam design
24-February	Continue beam design
3-March	SPRING BREAK
10-March	Continue beam design
17-March	Complete beam design, begin girder design
24-March	Complete girder design, begin column design
31-March	Complete column design, begin virtual model
7-April	Complete virtual model
14-April	Turn in draft report for review
21-April	Make edits to project report, turn in final product

SECTION 4: DESIGN

4.1 Framing Plan Layout

The team had received the Architectural Plans from the Architect that they used to mark up and place columns, girders, and beams. The design team started by analyzing the plans to determine ideal locations for columns to be placed given the different architectural constraints. Upon placing columns, they needed to be connected by a series of girders and columns. For each building the design team split up into smaller teams of two to analyze the specifics of each floor to include hallways, classrooms, and office spaces in order to properly place columns and add column spans that were manageable. In these teams columns, girders, and beams were marked and tributary areas were calculated to move onto the next step of the design. Special considerations were made for structurally interesting areas of the building that the team knew would require multiple beams. One such area like this includes the AHU (air handling units) on each buildings roof which required extra beams to carry the extra dead load.

4.2 Decking

When choosing a concrete on metal deck, the project team looked at the Verco Steel Floor Deck Catalog. This catalog provided a variety of decking options in terms of metal flute shape, concrete depth, etc. When making a selection, the first aspect of design the team considered was fire code safety. If the concrete slab is at least 3.5 in deep, then additional fireproofing would not be required. With the advice from Dr. Kuhn, the team looked at the plans of Shiley Hall that were available in room 206. Since Shiley Hall is of a similar type of building usage, it could be

concluded that they should have a similar type of deck. The team found this deck to be B Formlok™ with a concrete depth of 3.5 in. Therefore, this is the deck the team used in the design.

4.3 Load Determinations

The Dead Loads applied to the building are uniform. They include the weight of the concrete slab (60.4 psf), steel deck (2.3 psf), partitions (15 psf), and ceiling suspended MEP equipment (5 psf). The total dead load for the building is 82.7 psf.

The Live Loads that are on the building were not uniform and were determined based on the use of the area of the floor. This use was predetermined by the architect and the owner. Table 4-1 shows a table summary of these classifications and their respective loading.

Table 4-1. Live Loads by Usage

Floor Usage	Live Load (psf)
Lobby	100
Auditorium (fixed seats)	60
Corridor (first floor)	100
Corridor (second floor and above)	80
Offices	50
Classrooms	40
Heavy Storage	250

The Oregon Structural Specialty Code requires Snow Loads to be taken into consideration due to the climate in Oregon. The code states that the required minimum load to be considered for design is 25 psf, including a 5 psf surcharge for rain on snow. Since portions of the roof are to be flat and others are to be sloped, the team had to check two other equations. The Flat Roof Snow Load is calculated based on how much of the roof is obscured, a thermal factor, and an importance factor. The Sloped Roof Snow Load is calculated from a slope factor and the Flat Roof Snow Load. The team found both the Flat Roof Snow Load and the Sloped Roof Snow Load to be less than the required minimum. Therefore, a snow load of 25 psf was used for design.

4.4 Beams

The beam design was determined by calculating the respective tributary area that each beam was responsible for. Once the area was calculated, the loads for that section of the building was applied in order to size the beams according to the Steel Manual. With dead loads, including the concrete on steel decking, and live loads accounted for, the beams were able to be sized according to the maximum moments and shears experienced by the beam. The dead loads were determined to be 82.7 psf and 67.2 psf for the first/second floor and roof respectively. The loads were calculated out to a distributed load in psf for the beam and an online calculator was used to determine the maximum moment that would be used in the tables of the Steel Manual. Once the sizing of the beam was determined, the deflection was checked to ensure that it was within regulation which is to be less than the length of the beam divided by 180. This process was

repeated and tabulated to size all the columns in both buildings. These tabulations as well as sample calculations may be found in Appendix D.

4.5 Girders

The girder design is very similar to the beam design, just larger and dependent on point loads that were provided by the beams that are connected to the girders. For each girder, the sizing was determined by the maximum moments and shears, however the loading on these girders were more intensive as they carried distributed loads and point loads. The team calculated out the moments and reactions for each of the designed girders and tabulated the results to also be used in column design. These tabulations as well as sample calculations may be found in Appendix D.

4.6 Columns

The column design process incorporated the loads per floor on each column (dead loads, live loads, and snow loads), the weights of girders connecting to the columns, and the weight per foot of any columns above the respective column being designed. Tributary areas were established on each floor to determine the loading per floor on each column. The dead loads were calculated to be the same load values as determined in the beam design process (82.7 psf for the first and second levels and 67.2 psf for the roof level). The live load was determined in the same manner that it was determined when designing the beams. Furthermore, the weights of each girder connection to the column were added. These weights did not include the overall weight that the girder supports, it only included the weight per foot of length of the member.

Each column was determined to have a pinned/pinned connection at its base and top. This corresponded to a k value of 1.0. The heights of each column were determined by using the elevations of the architectural drawings. The ground to first level columns, and the first level to second level columns had heights of 16 feet. The second level to roof level columns were 14.67 feet. The loading determined and the effective height (k*height) were plugged into the tables in the Steel Manual to correspond with a column member that had a ϕP value greater than the total loading determined in the design team's calculations, utilizing the load and resistance factor design approach. The corresponding member was then selected for the finalized design. A summary of the columns for the classroom side of the building may be found in table 4-2. Sample calculations and a tabulated summary may be found in Appendix D.

Table 4-2. Summary of the Designed Columns for Classroom Building

Column Summary			
Ground to Roof Level	Load	Max Load	Member
C1	770.8878	865	W12x87
C2	652.5909	865	W12x87
C3	210.4981	865	W12x87
C4	211.6977	865	W12x87
C5	69.72013	865	W12x87
C6	94.30512	865	W12x87
C7	648.719	865	W12x87
C8	708.682	865	W12x87

4.7 Connections

The design team utilized the AISC Steel Manual to design two typical connections for the overall framing plan. The first connection was designated for all connections between beams and girders. The second connection was designated for all connections between girders and columns.

These connections were designed by selecting group A bolts with standard holes in the shear plate, while including the thread of the bolt within the connection to the shear plate. With these constraining values, the AISC Steel Manual tables for single-plate connections were utilized to determine the length of the shear plate, the thickness of the shear plate, and the maximum capacity of the connection based on the load and resistance factor design approach. The typical beam to girder connection had a maximum shear value of 42 kips. This shear value corresponded with a number of 4 bolts at ¾ inch and a shear plate thickness of ⅜ inch. The capacity of this connection type is 62.5 kips. The typical girder to column connection had a maximum shear value of 99 kips. This corresponded to a number of 9 bolts at 3/4 inch and a shear plate thickness of ¼ inch. The capacity of this connection type is 114 kips.

4.8 Column Footings

After the project team finished designing framing elements, they moved on to sizing footings that would support these elements. The soils report as provided by the geotechnical engineer states the allowable bearing pressure of the soil to be 2500 psf. Therefore, the project team was able to size the footings by taking the load exerted by the column, and dividing that by the bearing pressure, in order to determine a square foot area for the footings. The depth of the footings as recommended by the geotechnical engineer is 2 ft.

The load exerted by the column is determined by the combined load from each floor, the weight of each girder attached to that column, and the weight per foot of the column itself. A summary

of the sized footings for the classroom side of the building may be found in table 4-3. Sample calculations for sizing the footings may be found in Appendix D.

Table 4-3. Summary of Sized Footings for Classroom Building

Footings						
Column	Height	lb/ft of height	Weight	Loading	Soil Bearing Pressure (psf)	Footing Area (sqft)
C1	45.67	87	3973.29	770887.81	2500	308.36
C2	45.67	87	3973.29	652590.94	2500	261.04
C3	45.67	87	3973.29	210498.10	2500	84.20
C4	45.67	87	3973.29	211697.74	2500	84.68
C5	45.67	87	3973.29	94305.12	2500	37.72
C6	45.67	87	3973.29	69720.13	2500	27.89
C7	45.67	87	3973.29	648719.04	2500	259.49
C8	45.67	87	3973.29	708681.97	2500	283.47

4.9 Basement Wall

In the basement is the largest auditorium in the building is surrounded by soil, lacking framing members. Therefore, the project team needed to additionally determine the loads acting upon the wall that could be applied when designing the concrete for the wall. The loads acting upon the wall as determined by the geotechnical engineer are comprised of the weight of the soil, seismic loading, and surcharge loading.

In order to determine the weight of the soil acting upon the wall, the wall was treated as a vertical simply-supported beam, with the weight of the soil acting as a triangular distribution upon the "beam", peaking at 45 pcf at the bottom of the wall. Figure 4-1 shows a diagram conveying this idea.

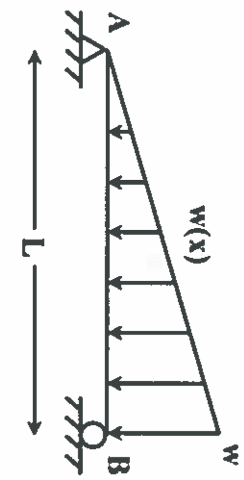
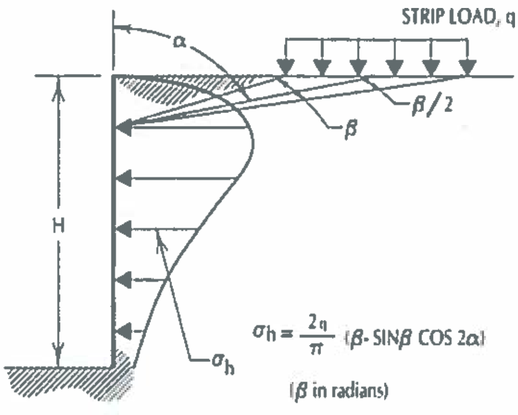


Figure 4-1. Triangular Distribution of Soil Weight Upon Basement Wall

The seismic loading upon the beam was expressed as 10 times the height of the wall, per the geotechnical report.

The surcharge loading describes loads that are imposed upon the soil close to the site. For example, if a fire breaks out, and a fire truck must drive close to the building, the weight of that truck will be felt by the wall. The geotechnical report conveys equations that allow the horizontal surcharge loading to be translated as a vertical loading upon the wall. Figure 4-2 conveys this translation as shown in the geotechnical report.



STRIP LOAD PARALLEL TO WALL

Figure 4-2. Horizontal to Vertical Loading Translation

With each of these load determinations, the height of the wall plays a pivotal role in calculations. As can be seen in figure 4-3, there are two heights that must be considered. The majority of the basement is 16 ft in height. However, the auditorium to be used for large classes is pitted, laying 3 ft deeper than the basement.

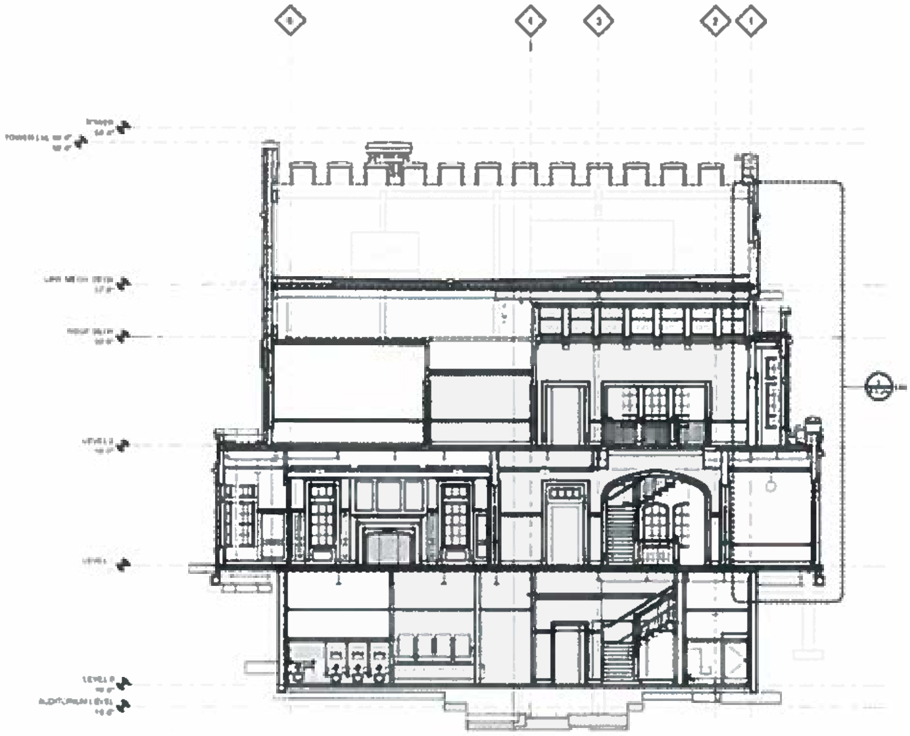


Figure 4-3. Elevation Profile of Dundon Berchtold Hall

These loads are superimposed upon each other. When totalled, the loading acting upon the majority of the basement is 927.6 lb/ft, and 1085.8 lb/ft at the deepest point of the auditorium. Calculations for this load determination may be found in Appendix D.

SECTION 5: CONCLUSIONS, SUMMARY, ACKNOWLEDGEMENTS

As a conclusion to this design, the project team was able to input their framing members into Revit software. This software enabled the team to create construction drawings for their design. These drawings may be found in Appendix C.

The main goal of this project was for students to learn structural design, apply that knowledge to a real-world project, and create a design package. The project team feels they have succeeded in these goals and hope the work of this report reflects that success.

The project team would like to acknowledge their industry advisors from KPFF, Soderstrom Architects, and Fortis Construction; Mr. Aaron Wegner, Mr. Andrew Burke, and Mr. Kevin Kelley, respectively. They would like to additionally thank their faculty advisors from the University of Portland, Dr. Mehmet Inan and Dr. Matthew Kuhn. Each one of these advisors provided immeasurable help and guidance for the completion of this project.

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APPENDIX A

TEAMWORK AND PROFESSIONALISM

A.1 Interaction and Organization

When the project was proposed the function of the team's first interaction was to establish the roles each member would play, decide how the team would handle stressful times, and how to interact with one another. Some of the positions and tasks that the team decided were necessary were point of contact, scribe, technical work, and writing work. No one member was in control as leader. Rather, the team worked together, keeping checks and balances on each other, and holding each other accountable for their role. It was decided early on that the key to the team's fluidity and cohesion would be an effective and truthful sense of communication. This team utilized modern technology to keep in constant contact with one another via text messaging. When keeping in contact with faculty and industrial advisors, the team chose a more formal approach using e-mail. They would consult with each other's calendars and then schedule meetings with an advisor. Then, as a group, they would draft meeting agendas with what they hoped to accomplish with their advisor. In the meeting they would ensure to hit every point of the agenda with an open flow of conversation that allowed for any member to feel comfortable addressing any further questions or topics they wished. In the case where a decision needed to be made, each member of the group was able to make their opinion known. Then they would talk with each other about the choices until they unanimously agreed on a final decision that worked for every member. When it came to actual design work, the team split up into two groups. Two members worked on design for the signature side of the building, where the other two worked on the classroom side. The two groups would come together as a whole to discuss the design process thus far and ensure both were performing to the best of their abilities.

A.2 Aspects of the Project Not Covered in Courses

Some parts of the project were not covered in the team's engineering courses and required independent research and learning by the group members. The first major discipline the team has yet to have covered in a class is reading construction contract documents. The team has utilized the knowledge of their industry advisor along with the construction experience of two group members to learn how to read the drawings. The other discipline the team has not been taught is structural steel design. Should the team choose steel for their design of the academic building, they would need to do research regarding designing structural frames with steel.

The project team met with their industry advisors to gain knowledge on design aspects they had not learned through their curriculum. This included learning beam, girder, and column design, along with establishing how to fulfill their scope of work within the time frame presented. In their meetings with Dr. Kuhn from the University of Portland, they received small focused lessons on these design aspects. In their meetings with Mr. Aaron Wegner from KPFF, they presented their design work thus far for analysis from the viewpoint of one who does such work in the structural engineering industry. To assist them in their design, the design team was given the *AISC Steel Construction Manual*. This manual is used consistently in structural steel design and proved to be an essential resource.

A.3 Engineering Tools

With this project, modern engineering tools needed to be learned and applied for the structural design. Table A-1 lists these engineering tools. These tools aided in the analysis and modelling of this design.

Table A-1. Modern Engineering Tools to be Learned and Applied

Tool	Purpose
RISA	Structural engineering software for analysis and design
Revit	Information modeling software for architects and structural engineers

A.4 Codes and Standards

With this project, certain codes and standards needed to be applied in order to ensure the building was built to proper and efficient design standards. Table A-2 lists these codes.

Table A-2. Codes and Standards to be Applied

Code	Code Sections	Description
City of Portland: Charter, Codes and Policies	24.10.040	Building Regulation - Lists other codes to be followed
Oregon Structural Specialty Code (2014)	Chapters 1-7, 9, 11-16, 19-23	Fire and Design
National Fire Protection Agency	NFPA 1 (2018)	Fire Codes

A.5 Billable Hours

Table A-3 lists billable hours for the spring 2019 semester for each member of the design team as organized by week. There is also a total number of billable hours provided for each team

member. The hours include site visits, meetings with industry advisors, meetings with the faculty advisor, meetings with each other, and individual work contributions.

Table A-3. Billable Hours for Each Member of the Design Team for the Spring 2019 Semester

	Week															
Team Member	**1/13**	**1/20**	**1/27**	**2/3**	**2/10**	**2/17**	**2/24**	**3/3**	**3/10**	**3/17**	**3/24**	**3/31**	**4/7**	**4/14**	**4/21**	**Total**
Leily Mojarab	1	6	5.5	4	3.5	2	3	0	2	4	4	6	6	4	4	55
Kyle Cadiz	1	6	7.5	4.5	4	2	2	0	3	6.5	6	6.5	6	2	2	59
Sofia Martinez	1	5	5	3	4	3	2	0	4	4	6	4	6	2	4	53
John Black	1	4.5	4	4	3.5	2	2	0	3	6	5	6	6	2	2	51

A.6 Individual Contributions

Leily Mojarab was responsible for writing section 1, the introduction. She also wrote sections 2.1, 2.5, 2.10, 2.11, 4.8, 4.9. Additionally, she contributed to filling out the necessary items in the appendices. Along with the other team members, she was a part of the editing process and discussed all aspects of the paper with the team to ensure the written report was complete in both quantity and quality.

Kyle Cadiz was responsible for writing sections 2.2, 2.3, 4.6, and 4.7. He also contributed to section 3 with writing about the evaluation of alternatives the team had completed. He also took part in the editing process with the team and participated in the discussions and research for various sections of the paper.

Sofia Martinez was responsible for writing sections 2.7, 2.8, 2.9, 4.2, and 4.3. She also contributed to appendix A the "Teamwork and Professionalism" section. She was involved with the team editing process as well as the research and discussions for different sections of the paper.

John Black was responsible for writing sections 2.5, 2.6, 4.1, 4.4, and 4.5. He also contributed to section 3 with writing about the design approach the team took with their project. He was involved with the team editing process as well as the formation of the paper along with individual research for his sections and the alternative design sections of the paper.

APPENDIX B

MEETING AGENDAS AND MEETING MINUTES

Meeting with Mr. Wegner 1/24/19

Attendees	Present
Leily Mojarab	X
John Black	X
Kyle Cadiz	X
Sofia Martinez	X
Dr. Inan	
Mr. Wegner	X
Mr. Burke	

1. Share preliminary column layout

2. Discuss dead load and live load process

3. Questions
    a. Where columns are needed on the perimeter of the first and second floor, do they get fastened to the retaining walls of the basement?

    b. Are the two wings seismically isolated?

    c. Do we need to take live load reductions into account?

    d. How far are we taking lateral loads, that is, are we designing a lateral force resistance system?

Meeting with Dr. Kuhn 1/25/19

Attendees	Present
Leily Mojarab	X
John Black	X
Kyle Cadiz	X
Sofia Martinez	X
Dr. Inan	
Dr. Kuhn	X
Mr. Wegner	
Mr. Burke	

1. ASCE 7 and Steel Manual for reference

2. Update on steel layout and dead/live loads

3. Questions
   a. What do we need to know as we work on the gravity and lateral loads?

   b. Are there any lessons/procedures you can teach us in order to compute these loads?

   c. For the future of setting up meetings, would you prefer to meet the specific people working on different loads at a time vs the whole team? (i.e. Leily and Kyle for dead/live loads and then Sofia and John for lateral loads)

Meeting with Mr. Wegner 2/7/19

Attendees	Present
Leily Mojarab	X
John Black	X
Kyle Cadiz	X
Sofia Martinez	X
Dr. Inan	
Mr. Wegner	X
Mr. Burke	

1. Share calculations

2. Discuss exterior wall dead loads (brick spacing between windows, and windows)

3. Questions
   a. How do you size the beams and column? Is there anything in the steel manual?

   b. Is there anything to guide you to select a steel deck?

   c. Does the brick façade anchoring transfer the load to the slab, making it a story load, or does it transfer straight to the ground?

   d. How do we start live loads? Can we take the max load from each floor?

Meeting with Dr. Kuhn 2/15/19

Attendees	Present
Leily Mojarab	X
John Black	X
Kyle Cadiz	X
Sofia Martinez	X
Dr. Inan	
Dr. Kuhn	X
Mr. Wegner	
Mr. Burke	

1. Clarifying steel deck design (gauge, c-c span vs. clear span)

2. Present classroom building framing plan

3. Discuss RISA

4. Questions (if any)

Meeting with Mr. Wegner 3/21/19

Attendees	Present
Leily Mojarab	X
John Black	X
Kyle Cadiz	X
Sofia Martinez	X
Dr. Inan	
Mr. Wegner	X
Mr. Burke	

1. Discuss shared calculations:
   a. Dead load summary

   b. Beam design calculations (Is this the most efficient way to design a beam with point loads?)

2. Is RISA a better way to design or is our method substantial?

3. New processes to discuss:
   a. Footing design

   b. Column design

   c. Connection design

Meeting with Mr. Wegner 4/4/19

Attendees	Present
Leily Mojarab	X
John Black	X
Kyle Cadiz	X
Sofia Martinez	X
Dr. Inan	
Mr. Wegner	X
Mr. Burke	

1. Share calculations

2. Scope of Work adjustment

3. Economic analysis

4. Connections

Meeting with Inan – 1/18/19

- Presented Dr. Inan with our column layout
  - Asked about if we are only using one wing
  - We will ask Aaron to tell us how to correctly do this
- Informed him about our future meetings
  - Aaron Thursday
  - Us Wednesday
  - Kuhn (Room 242) Friday at 12:30-1:30
  - Inan meeting at 10:00am on Tuesdays
- Inan met with Dr. Kuhn
  - Loading criteria
  - Good for us to come up with a layout first and present it to Aaron.
- Inan heard from other professors
  - This group did not progress as far as we should have
  - Should have had loads analyzed already
- Meeting with Aaron on Thursday
  - We should present him with material instead of questions so we can push ahead
- This semester
  - Delegate more work between the four of us instead of all of us doing stuff together
  - Focus on Dr. Kuhn for Structural
  - Focus on Inan for coordination
  - Meet with Inan and Kuhn every week
    - Prepare agenda for Kuhn only
    - Prepare minutes for all advisors' meetings
- Andrew Burke
  - Ask for a meeting in a month
  - Seismic Architecture
- Kevin Kelly
  - Ask for another site tour

Meet with Inan Tue. 29th at 10:00am

Minutes 1/24/29 @ 8:59am

1. Provided Mr. Wegner with our preliminary column layout
    a. Look for places where columns line up vertically
    b. Columns can disappear as they go up the building
    c. There is no right or wrong answer
2. Dead and Live Loads
    a. Find tables for materials
        i. Table in back of ASCE 7
        ii. Steel manual
    b. Use architectural details to find composition of roof, walls, floors, etc.
    c. Add 15 psf to account for mechanical and electrical equipment
    d. Design for minimum loads (in notes)
        i. Design whole floor for greatest minimum
    e. Tributary areas
        i. Simplify
    f. Accounting for material that you have to calculate
        i. Iterative process
        ii. Steel beams – usually small weight compared to load on it
        iii. Steel manual lists weights
    g. Concentrated live load
        i. Check calculations but usually tributary area takes control
        ii. Figure out what is the worst effect
            1. For bending of beam – mid span
            2. For shear – at connection
    h. Check minimums – 25 psf for flat roof load
        i. 5 psf surcharge for rain on snow
    i. Wings are not seismically isolated
        i. Calculate for the whole building
        ii. Seismically isolating prevents twisting
        iii. We can consider putting a joint in
    j. Need for live load reductions
        i. Don't need to but we can (and should)
    k. Designing a lateral force resistance
        i. No
        ii. If we have time at the end we can
    l. Columns to retaining wall
        i. Can either bump out wall
        ii. Or can push column outside of wall
    m. Take seismic loads to base shears using the equivalent lateral force method
        i. Save for a little bit later after gravity
        ii. Need weight of building
        iii. Can do wind loading after seismic to compare what will control the building (won't be wind)
3. Following loads,
    a. Layout columns and beams in RISA

b. Fire rating will give you thickness of deck, which will give you span of your deck which will give you spacing of your beam

Meet Aaron two weeks from now after we attempt everything else.

End: 9:42am

Meeting with Kuhn 1/25/19 @ 12:28 pm

1. Discussed Dead and Live Load Calculations
    a. Snow Loads - Leily
        i. On grid paper
    b. Dead Loads - Kyle
        i. 15 psf for mechanical and electrical
        ii. Don't think we need specs
        iii. Verco Catalogue for steel decking
        iv. Calculate the dead load at each level of the building
            1. Including the brick
                a. Brick from half way between 2nd and 3rd floor account for weight on roof diaphragm
        v. Partition = 15 psf
    c. Live Load Reduction
        i. Use to make structure lighter
2. Seismic - Sofia
    a. Need to layout shear walls
    b. Calculate the building weight
    c. Need dead load no live loads
    d. Concrete floors, roof, brick tiles, (partition = 10psf) = seismic weight
3. Wind Loading – John (see Dr. Kuhn)
4. Column, Girder, and Beam Layout
    a. Decide on a girder and beam layout and take to Aaron in the next two weeks
    b. Find the deck depth from OSSC
5. Goals
    a. Live loads
    b. Dead loads (mostly, maybe have some questions)
    c. Layout of Columns, beams, and girders
6. Scanning
    a. Set to 600 dpi

Meet in two weeks roughly

End @ 1:08 pm

Meeting with Inan – 1/29/19 @ 10:03 am

1. Minutes from meeting with Kuhn & Wegner
    a. Calculation on snow loads
        i. Reviewed with both Kuhn & Wegner
        ii. Ask about minimum loads
    b. Did we get a lot of information from Mr. Wegner?
        i. Yes, answered questions about:
            1. Dead loads
            2. Live loads
2. Distribution of Work
    a. Rough distribution
    b. Need to all focus on dead loads right now
3. Seismic
    a. Inan would like us to design bracing system
    b. Kuhn agreed designing bracing system is a lot
    c. Most important that we get the loads from the seismic and the wind
    d. Maybe when we start RISA design some could split off and do bracing design
4. Generally, meetings with Kuhn are support
5. Column Layout that was reviewed with Aaron
    a. Make a new layout, using the older one
6. Budget for print outs
    a. Awaiting approval
7. By next meeting with Aaron
    a. Have dead loads mostly dead
    b. Have some live loads done
8. Timeline
    a. Plan to do analysis by 2nd or 3rd week of February
    b. Revise and design after spring break
9. LEED – Ask Aaron

Next Meeting 1/5/19 @ 10:00 am

Meeting with Inan 2/5/19 @ 10:16am

1. Last time we met:
    a. Split up dead loads
    b. Sofia is doing furniture
    c. John is doing roof
    d. Leily is doing snow loads
    e. Kyle is doing wall and buttresses
2. Presented Dr. Inan with the large printed sheet plans (Soderstrom's work)
    a. We received budget to pay for these sheets and sheets for our final submittal
    b. Use money to print out partial plans during presentations
    c. Or, Print out larger prints with our own printing money
3. Straying from Gantt chart
    a. Put comments on item number 2 in progress memorandum
4. Future meetings
    a. Aaron on Thursday (2/7)
    b. Kuhn on Friday (2/8)
    c. Inan on Tuesday (2/12)
5. Poster Feedback
    a. Overall: Good
    b. Improve content
    c. Add technical formulas
    d. Better pictures and drawings
6. Group will send Inan feedback about poster presentations and questions for him to share with CE faculty.

End at 10:51 am

Next meeting February 12, 2019 @ 10:00 am

Minutes 2/7/19 @ 9:05 am

Questions for Aaron:

1. Deadloads of floors
   a. Use 5 psf for wood floor
   b. Find finish with the largest weight and use it for whole finish dead weight
2. Furniture loads
   a. Furniture is accounted for in the live loads
   b. Unless you are sure that a piece of "furniture" (or equipment) is fixed forever
3. Exterior wall loads
   a. Can ignore the windows for dead loads
   b. Can calculate weighted average between brick (40psf) and window (10-15psf) for a solid wall for calculating mass for earthquake loads.
      i. Weight of limestone will be close to weight of brick
   c. Brick is stacked from foundation to roof line (max is 30ft but city allowed 32ft)
      i. Ledger supports brick higher than that
      ii. Brick above the ledger angle gets applied to the steel frame through the roof
   d. Masonry tie anchors only take tension and compression loads

Live Loads:

1. How to determine live loads (conservative uniform or otherwise)
   a. 100 psf for first floor
   b. For higher floors, do by usage

Sizing Steel:

1. Use Steel Manual's table and look up unbraced length for <u>columns</u>
   a. There are equations in the back to calculate the strength of column, buckling capacity, etc. Should match what is in the tables
2. Also table for <u>beams</u> that give you capacity based on sections
   a. Tables to account for lateral buckling too for larger spans
3. Check chapter on modes of failure
4. Can design columns for tributary area or design for beams and design columns for reactions for beams
5. Ask Dr. Kuhn for a copy of Steel Manual or check the library

RISA and Revit:

1. Model it in Revit first, and then transfer it to RISA
2. Won't be a perfect transfer
3. RISA Floor would be good for modeling each floor individually
4. Aaron uses RAM Structural system

End: 9:50 am

Minutes from Meeting with Dr. Kuhn 2/8/19

1. Share calculations
   a. Dead weight = weight of the building
      i. Steel beams add to that but not significantly – do this calc last
   b. Only focusing on gravity loads
   c. Seismic tributary areas are horizontal
      i. ½ the weight to the bottom floor, ½ to the top
      ii. Seismic weight = 10 psf
   d. 16 psf floor finishes
      i. Will need to find the weight of the concrete slab underneath
      ii. Look at Verco pdf for concrete
   e. How do we pick a deck?
      i. Ask Aaron
      ii. Look at Shiley Hall construction plans in SH206 for a starting point
      iii. Verco will give us all information on the concrete

2. How do you size the beams and column? Is there anything in the steel manual?
   a. Dr. Kuhn has provided us with a copy of the Steel Manual
   b. Start by selecting a deck
      i. Then find the DL of the slab
      ii. Place beams
         1. Perpendicular to ribs on deck
      iii. Place girders
         1. Support beams
         2. Pin support at beam web is best for gravity (unless cantilever)
      iv. Place columns

3. Structural Design Process
   a. Find all dead and live loads
   b. Compute combined (factored) load Wu
      i. 1.2DL + 1.6LL
   c. Design for moment
      i. Find Mu due to Wu (page 3-213 in Steel Manual)
      ii. Select a W-Shaped beam
      iii. $\phi Mn \geq Mu$ (page 3-24)
   d. Check deflection (page 3-213)
      i. $\Delta = 5wl^4/384EI$ (w = unfactored live load)
      ii. $\Delta/l \leq 1/360$ (OSSC)
   e. Check shear
      i. $\phi Vn \geq Vu$ (shear diagram) (page 3-24 for shear strength)

4. Does the brick façade anchoring transfer the load to the slab, making it a story load, or does it transfer straight to the ground?
   a. Distribute wall weight for all three floors
   b. Floors 1-2 supported by ground foundation

c. 2-3 supported by steel
d. 3-roof stacked and supported by 1st roof slab

Meeting with Inan 2/14/19 @ 10:00am

1. Showed Dr. Inan our new framing layout for the classroom building
    a. Layout is to be used for preliminary calculations
    b. We are considering what pieces are flexible as if we were to meet with the architect
        i. However, we cannot do the actual iterative process with our architectural advisor
    c. Framing layout consists of first floor, second floor and roof of classroom building
2. Next Steps:
    a. Framing for signature building
    b. Tributary areas for classroom building
    c. Meet with Dr. Kuhn on 2/15/19
    d. Meet with Mr. Wegner the week of 2/18/19

End at 10:26 am

Next meeting February 19, 2019 @ 10:00 am

Meeting with Kuhn 2/15/19 @ 12:32 pm

1. What are we ready for?
    a. Tasks we have distributed:
        i. Tributary Areas
        ii. Signature framing
        iii. Finish dead and live loads
2. Progression of design
    a. Slab → beam → girder → column
3. Spans – explained by Dr. Kuhn
    a. Don't let the decking change our design, contractor usually orders the decking so if it is within the manufacturer's limitations, we are ok
    b. Use PLW-3 decking
    c. Use Verco tables to determine the concrete thickness
    d. Avoid using decking that requires shoring as consideration for the contractor and owner (saves time and money)
4. Beams
    a. Buy by weight (per length)
    b. The deeper the beam the more capacity
    c. Beam depth is usually discussed with architect to negotiate floor to ceiling height
    d. General rule, [beam depth (in)]*2 = [span length (ft)]
    e. We will probably end up with ~6~ types of beams to design
    f. Don't forget roof loads
5. RISA
    a. We want to use it to analyze the structure
    b. Dr. Kuhn feels RISA would only be helpful when checking seismic design
    c. For gravity design, it would be quicker to do by hand
6. Ask Aaron
    a. Are we designing the support system for the large air handling units on the roof

Meet after we finish with beams and girders.

End @ 1:04 pm

Meeting with Inan 2/26/19 @ 10:03am

1. Showed Dr. Inan Tributary Area Prelim layout
2. Make sure we are following Aaron's outline for us
    a. We are over half-way through this list
3. Meet with all advisors after spring break
4. LEED consideration is in the grading rubric
5. Founders Day: 10:15-11:15am present in Shiley 124
    a. When discussing seismic design, we can show preliminary calculations and talk about future plans with these calcs
    b. Do a mini-outline in the presentation like we should in a report
6. Questions for Aaron
    a. Do we want to do diaphragm calcs for written report (not presentation)?

End at 10:27 am

Next meeting March 12, 2019 @ 10:00 am

Meeting with Inan 3/19/19 @ 10:08am

1. Update:
    a. Classroom building beams almost done
    b. Assembly line:
        i. Sofia and John – Tributary Area
        ii. Kyle and Leily – Beam design and selection
    c. Completed items:
        i. Slab
        ii. Column Layout
        iii. Girder and beam layout
    d. Begun envision checklist
        i. We can only effect a few items on checklist
2. Meeting with Aaron:
    a. Ask if our work is correct
    b. Is there a more efficient way to do this?
    c. Send calcs to Aaron ahead of time with agenda
    d. Ask about foundations
    e. Ask about envision
3. Prepare for Founders Day on our April 2nd meeting
4. Written Report
    a. Have them stored online (also physical)
    b. Philip Vue will contact the class
5. Ethics Panel
    a. Is it ok that we are talking about architecture and furniture
    b. Yes – we need to be careful

End at 10:42 am

Next meeting March 26, 2019 @ 10:00 am

Minutes 3/21/19 @ 9:15 am

Reviewing calculations

1. Ceiling load is 5-10psf
2. Seismic weight is its weight
3. Concrete topping plus filling of flutes - 60.4psf
4. Weight of metal deck – 2.3psf
5. Partitions are dead load for this type of building
    a. Live load for office building
6. Greatest deflection depends on span (OSSC or IBC)
    a. Roof with no brittle material (~L/180)
    b. Limit deflection to 1in
7. Camber – must be specified
    a. Takes dead load deflection
    b. Come into play with long beams (<20ft, >100psf, <10in don't camber)

Designing for point loads

1. RISA could help
2. Follow load path from Slab → beam → girder → column → footing

Designing for Connections

1. Steel Manual Connection Tables
    a. Single plate connection (cheapest, most common, works for most connections; Table 10.9.a)
    b. A325 normal bolt
    c. A490 a little stronger bolt
    d. 3/8th in plate thickness
    e. Compare capacity to beam reaction

Footing design

1. Single column footing
    a. Find load, divide by allowable bearing pressure

Column design

1. Tables in the steel manual account for all the kinds of failure

What Ethical issues does a structural engineer face?

1. Spending more money on life safety
2. Being honest and telling the truth when you make a mistake
    a. Proactively fix your mistakes when you notice them
3. Building always has to meeting building code
    a. Building will stand for as long as it takes to get people out before it collapses after an earthquake

End: 9:54 am

Meeting with Inan 3/26/19 @ 10:00 am

1. We met with Aaron – went well
    a. Discussed Footing, Column, and Connection design
    b. Discussed ethics panel
    c. Plan to meet once more next Thursday before presentation
2. Will meet with Dr. Kuhn
3. Using REVIT to build CAD model
4. Ethics panel
    a. Write summary to Inan beforehand
    b. Include in Miscellaneous appendix

End at 10:20 am

Next meeting April 2, 2019 @ 10:00 am

Meeting with Kuhn 3/29/19 @ 12:30 pm

Update:
1. Done with tributary areas
2. Currently working on girders

Educational Value:
1. Maybe want to move on to columns – ask Inan
    a. Might have gotten all of the educational elements from it already
2. Ask Inan if we want to only do a couple columns

Column Design
1. Keep dead and live loads separate
    a. Reductions only apply to live loads
2. Maybe design one column per area type – upon Inan's approval
3. Good candidate for columns is "square" W-shape
4. Create table of DL, LL, SL per floor
5. Ask Aaron about a column arrangement

Footing Design
1. Find greatest of load combinations 16.9, 16.10, 16.11
2. Find foot print dimensions

Basement Wall Design
1. 45lbs/cubic feet
2. Steel manual has a triangular load equation
3. Pilasters to take vertical load
    a. Bump walls inward to make way for pilasters

End @ 1:21 pm

Meeting with Inan 4/2/19 @ 10:02 am

Oral Presentation

1. Send Inan our slides ahead of time – by Monday
2. Similar introduction – may be people from outside
    a. Make it attractive
3. Include a lot about loads and design
4. Show Frames, Elevations and Plans
5. Show girders and beams
    a. Include formulas
6. Simplify terms for non-engineers
    a. Still include technical stuff
7. Include information about soil pressure
8. Include an animation of plugging in numbers to equations
9. Show what members we designed in framing plan
10. STRONG TECHNICAL EMPHASIS

Final Meetings

1. One more meeting with Aaron and Kuhn

End at 10:25 am

Next meeting April 2, 2019 @ 10:00 am

KPFF Minutes 4/4/19 @ 9:00 am

Change in Scope of Work

1. Discussed a change in Scope of Work with Aaron – he thinks this is a good idea

Sharing Calculations

1. Kyle discussed his spreadsheet with Aaron
    a. Design columns by tributary area only.
    b. Add 10 psf to dead load when multiplying area by tributary area to account for beams and girders
2. Leily shared her calculations for the basement wall
    a. Aaron suggests adding on loading for seismic effect
    b. Find vertical surcharge "firetruck" load
    c. Add moments and shears from three loadings together where they occur

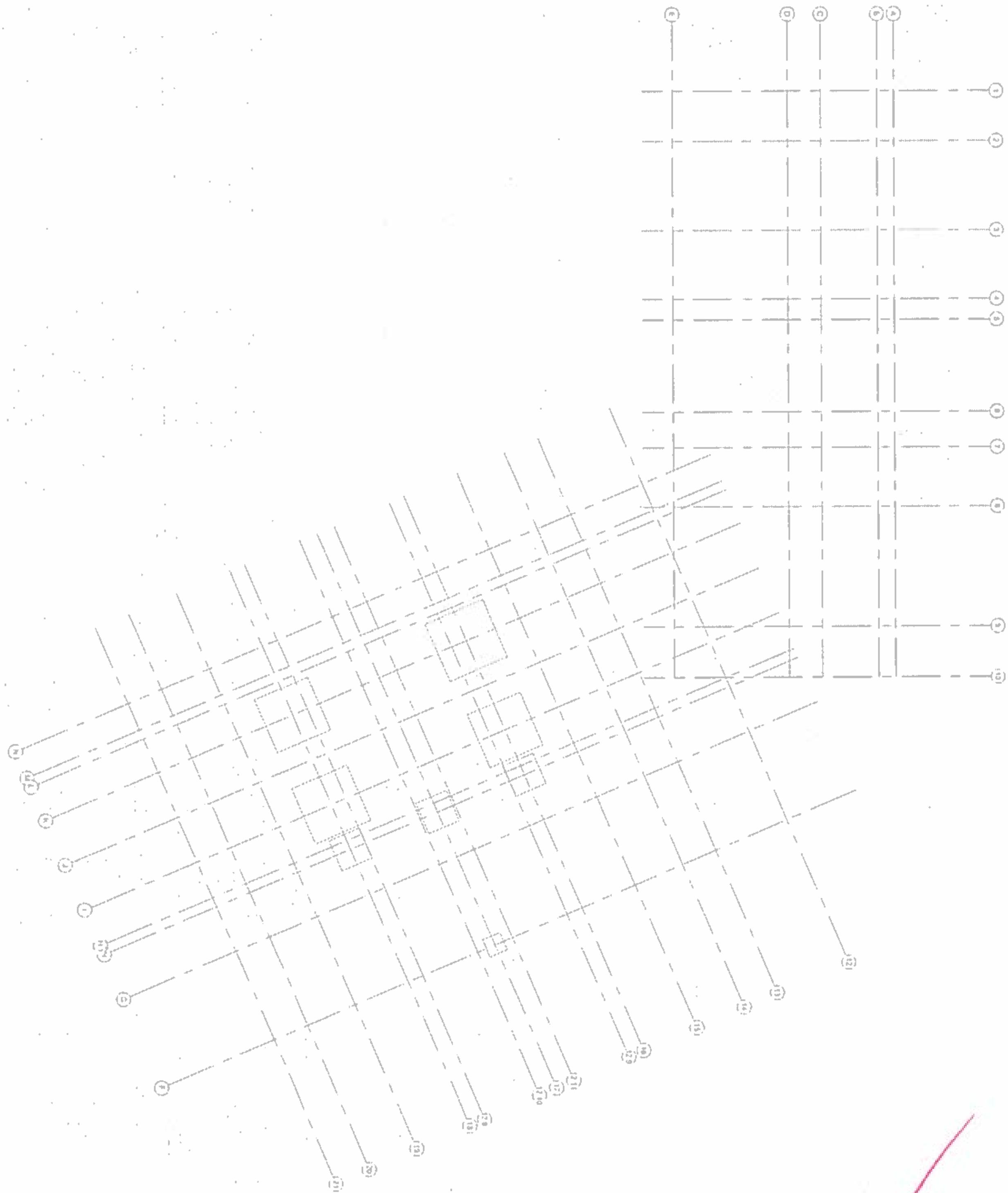
Economics

1. Steel bought in tons and in labor
    a. Since we don't have all of our members: find an average ton per square foot and extrapolate to the whole building
2. Concrete is in cubic yard
3. Also determine rebar and steel decking
4. Contractors secure pricing
    a. Contact Kevin Kelly
5. Resource: RS Means – book of cost estimation for construction

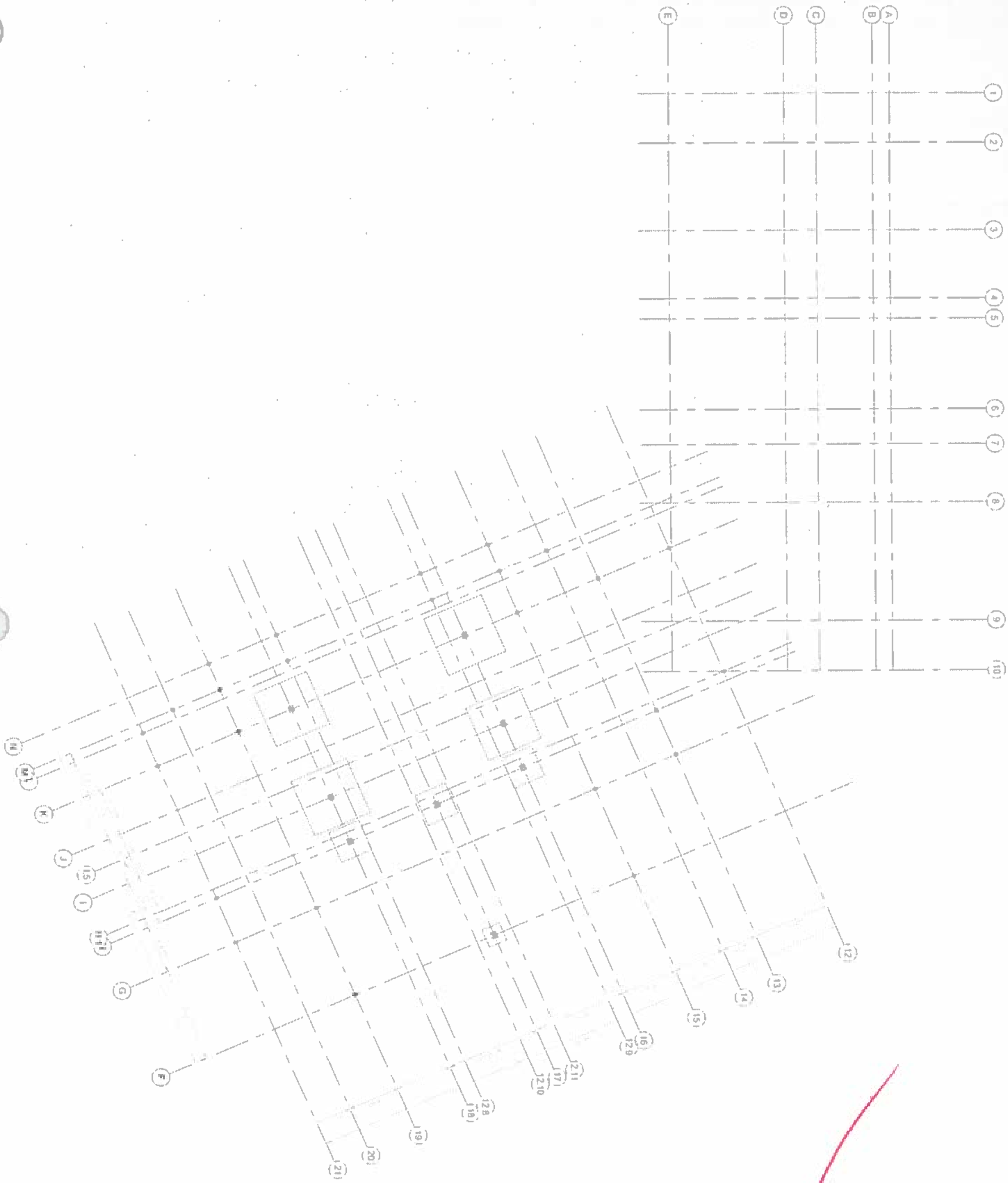
End: 9:45 am

APPENDIX C

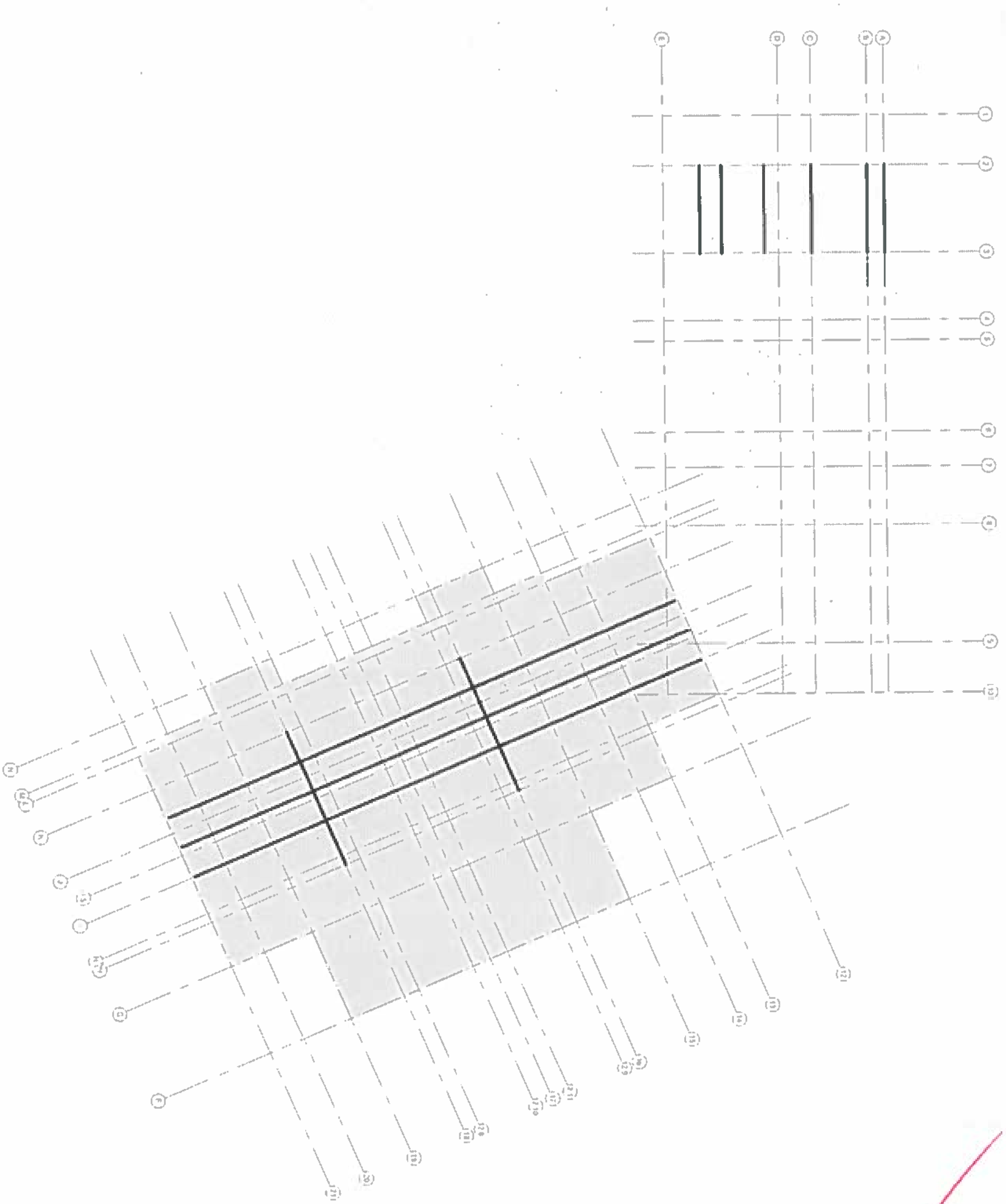
DRAWINGS



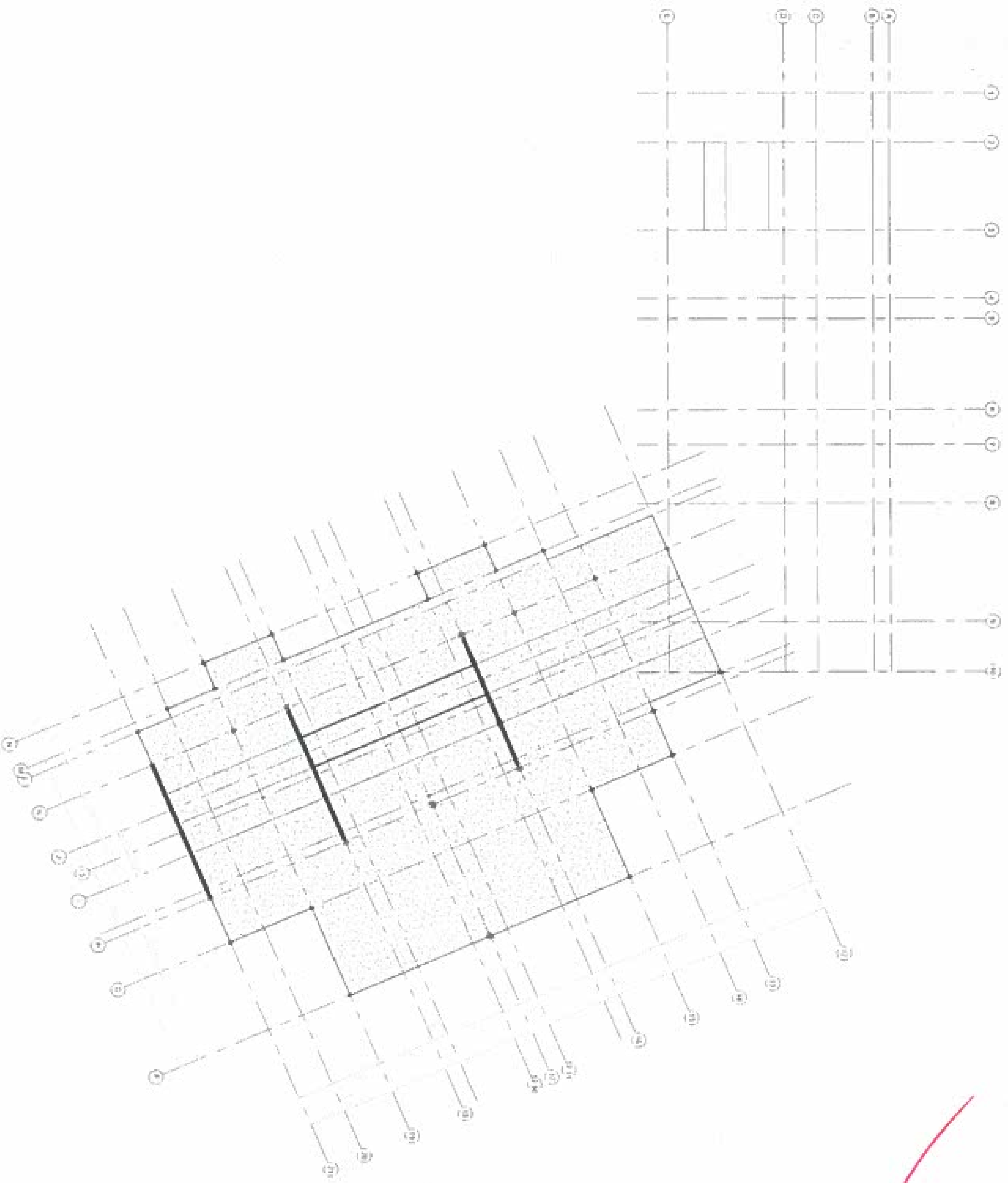
DATE 4/18/2019	DUNDON-BERCHTOLD HALL STRUCTURAL FRAMING PLAN	BASEMENT LEVEL PLAN VIEW	S.1



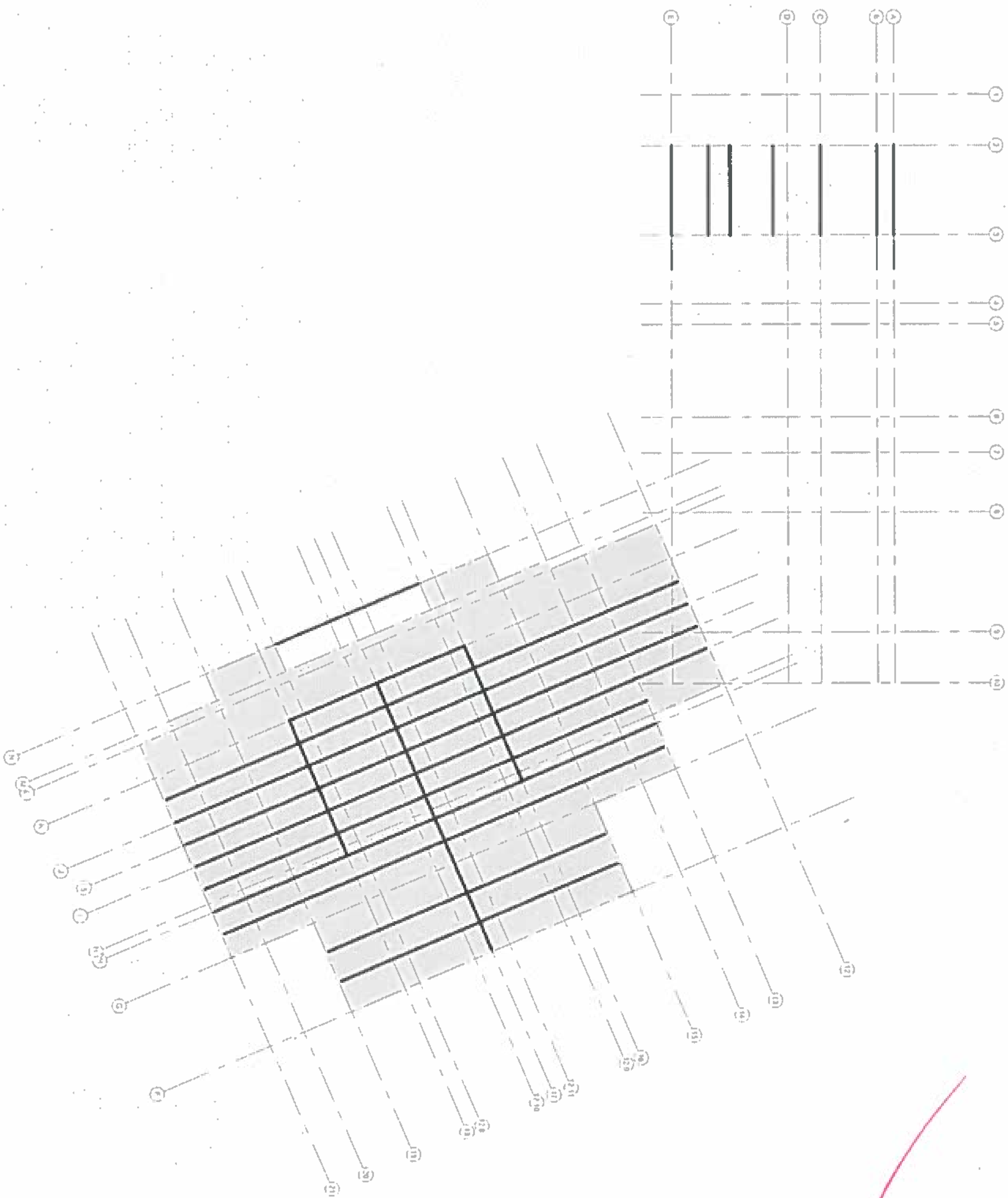
DATE 8/2019	DUNDON-BERCHTOLD HALL STRUCTURAL FRAMING PLAN	BASEMENT LEVEL CLASSROOM BUILDING PLAN VIEW	S.1.1



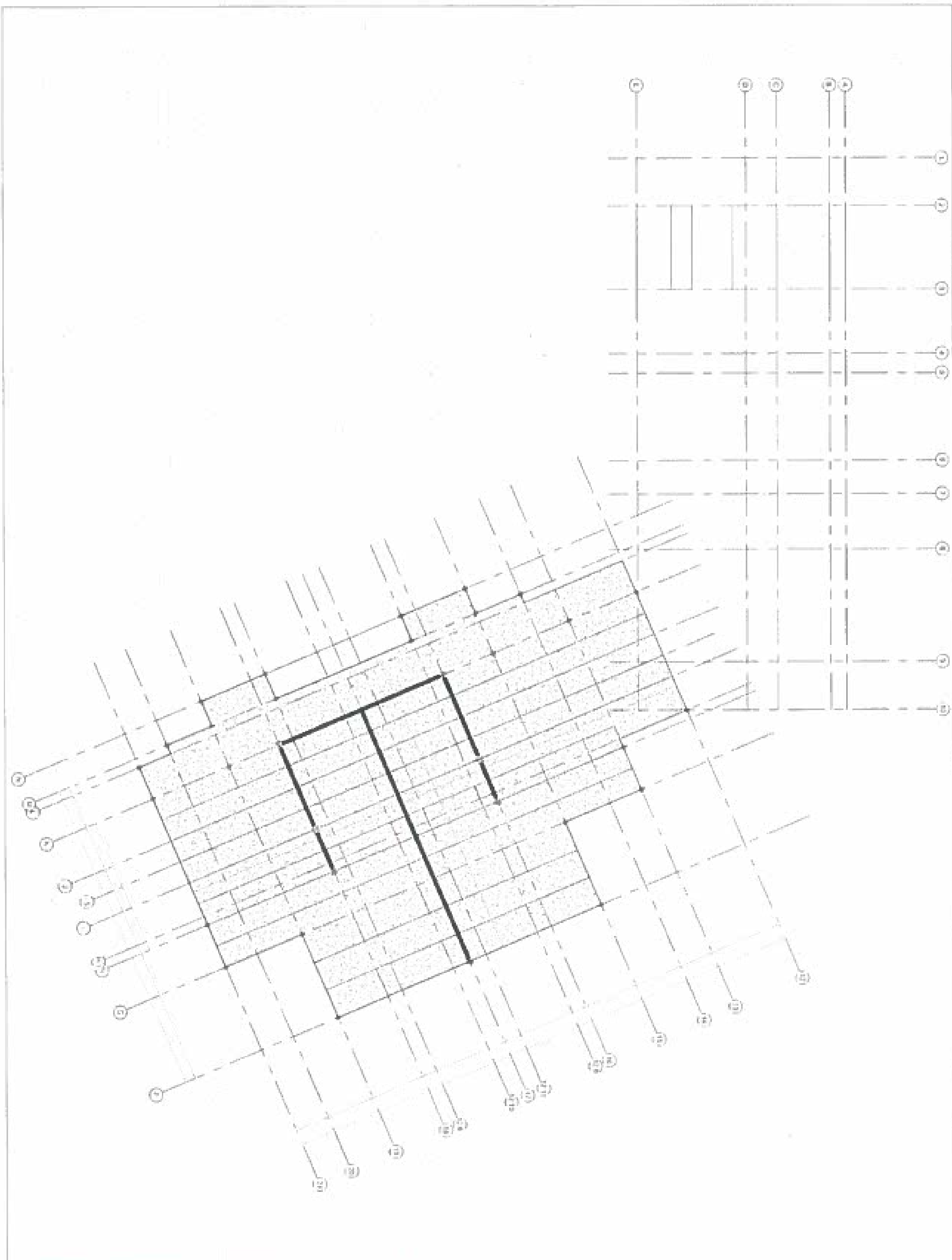
DATE 8/2019	DUNDON-BERCHTOLD HALL STRUCTURAL FRAMING PLAN	FIRST FLOOR PLAN VIEW	S.2



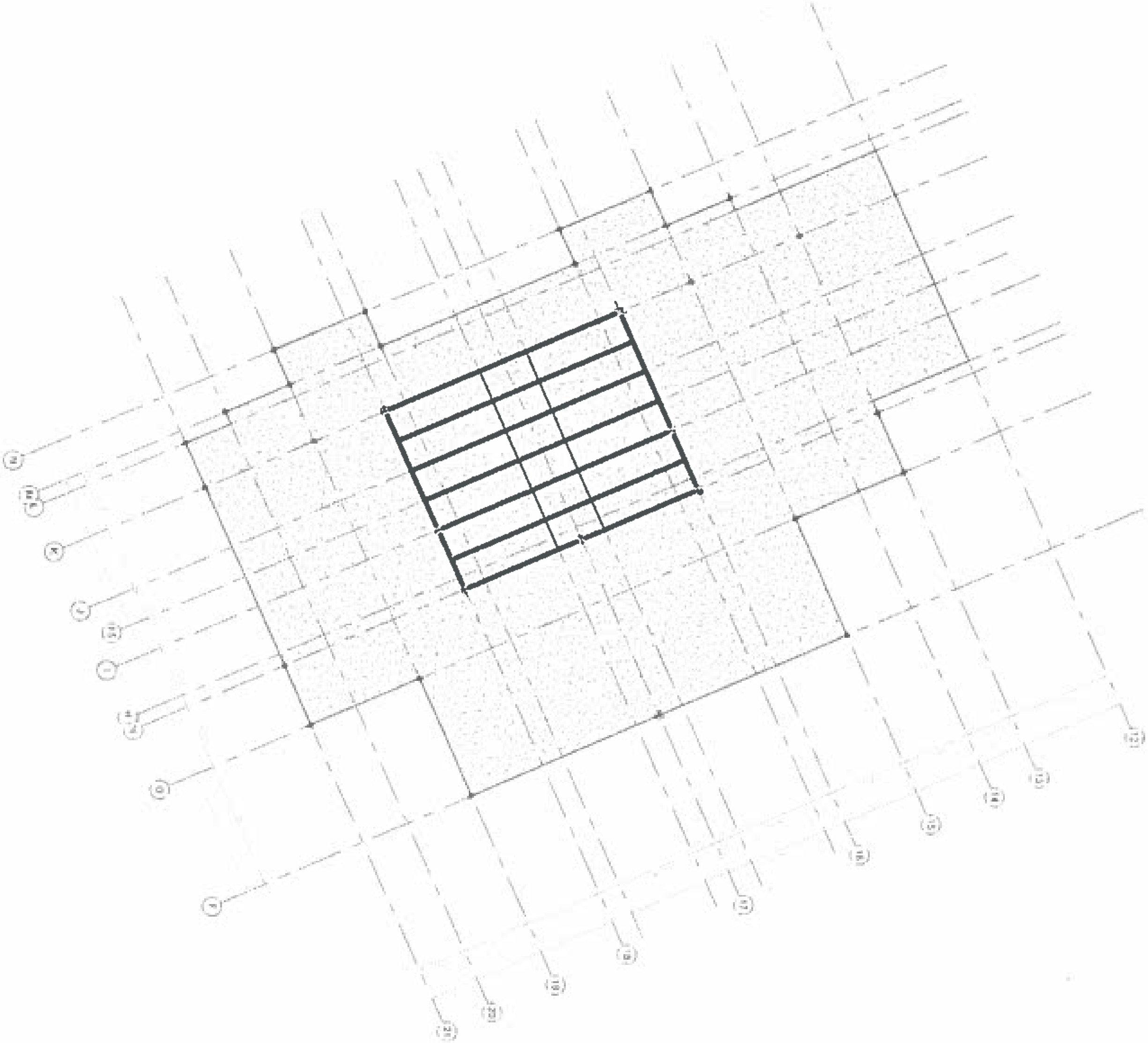
DATE /2019	DUNDON-BERCHTOLD HALL STRUCTURAL FRAMING PLAN	FIRST FLOOR CLASSROOM BUILDING PLAN VIEW	S.2.1



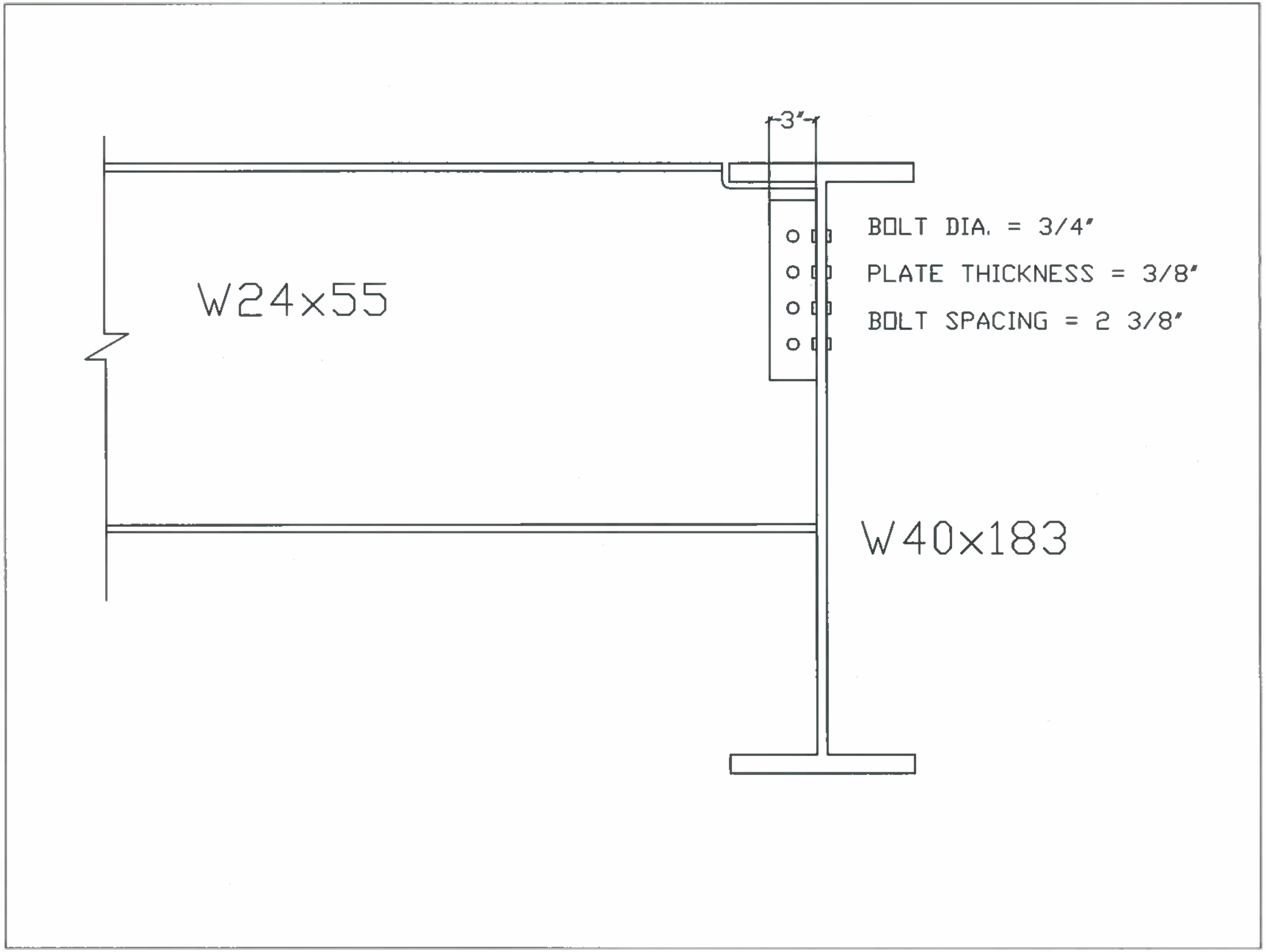
DATE 4/18/2019	DUNDON-BERCHTOLD HALL STRUCTURAL FRAMING PLAN	SECOND FLOOR PLAN VIEW	S.3



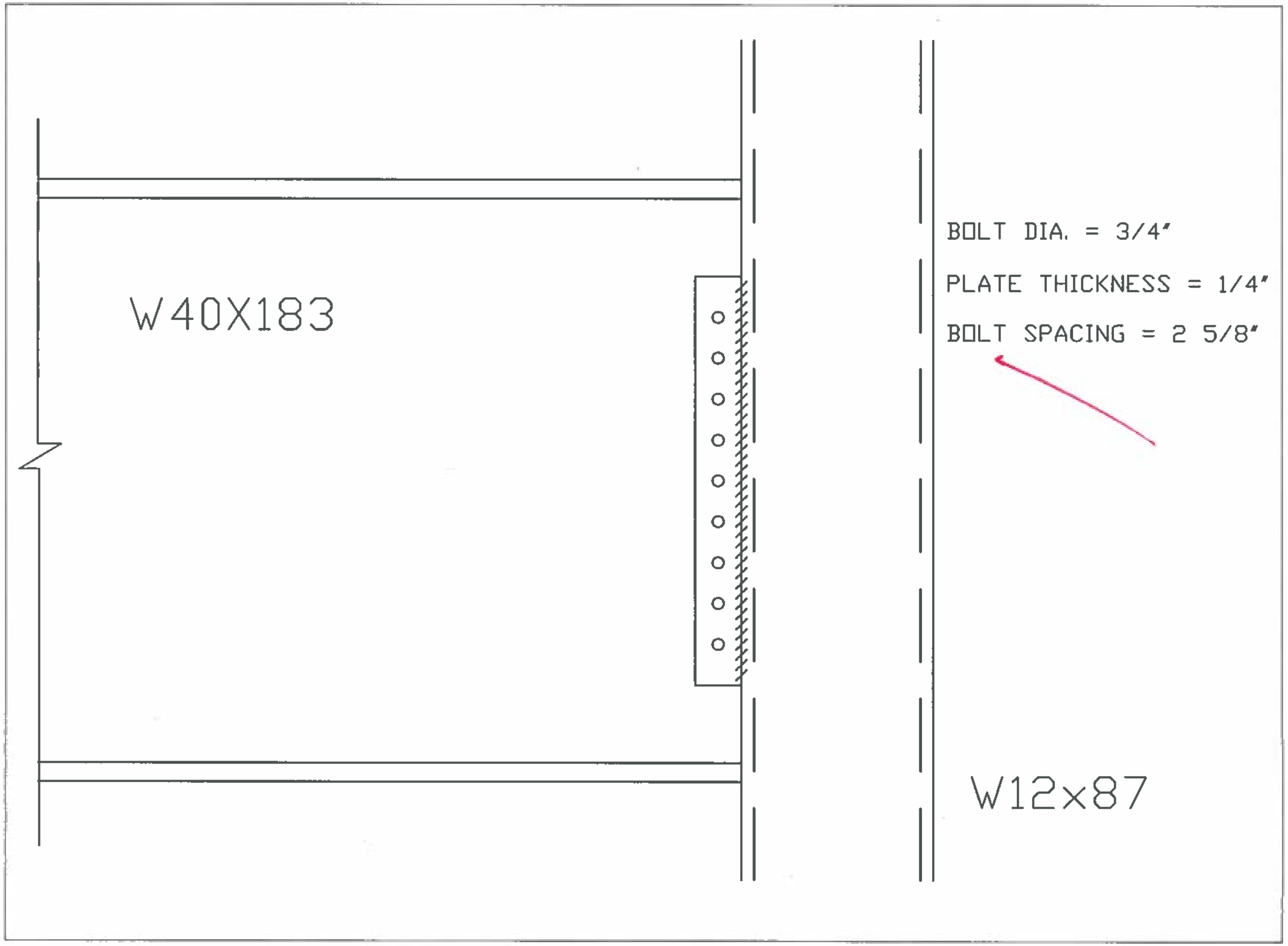
DATE 4/18/2019	DUNDON-BERCHTOLD HALL STRUCTURAL FRAMING PLAN	SECOND FLOOR CLASSROOM BUILDING PLAN VIEW	S.3.1

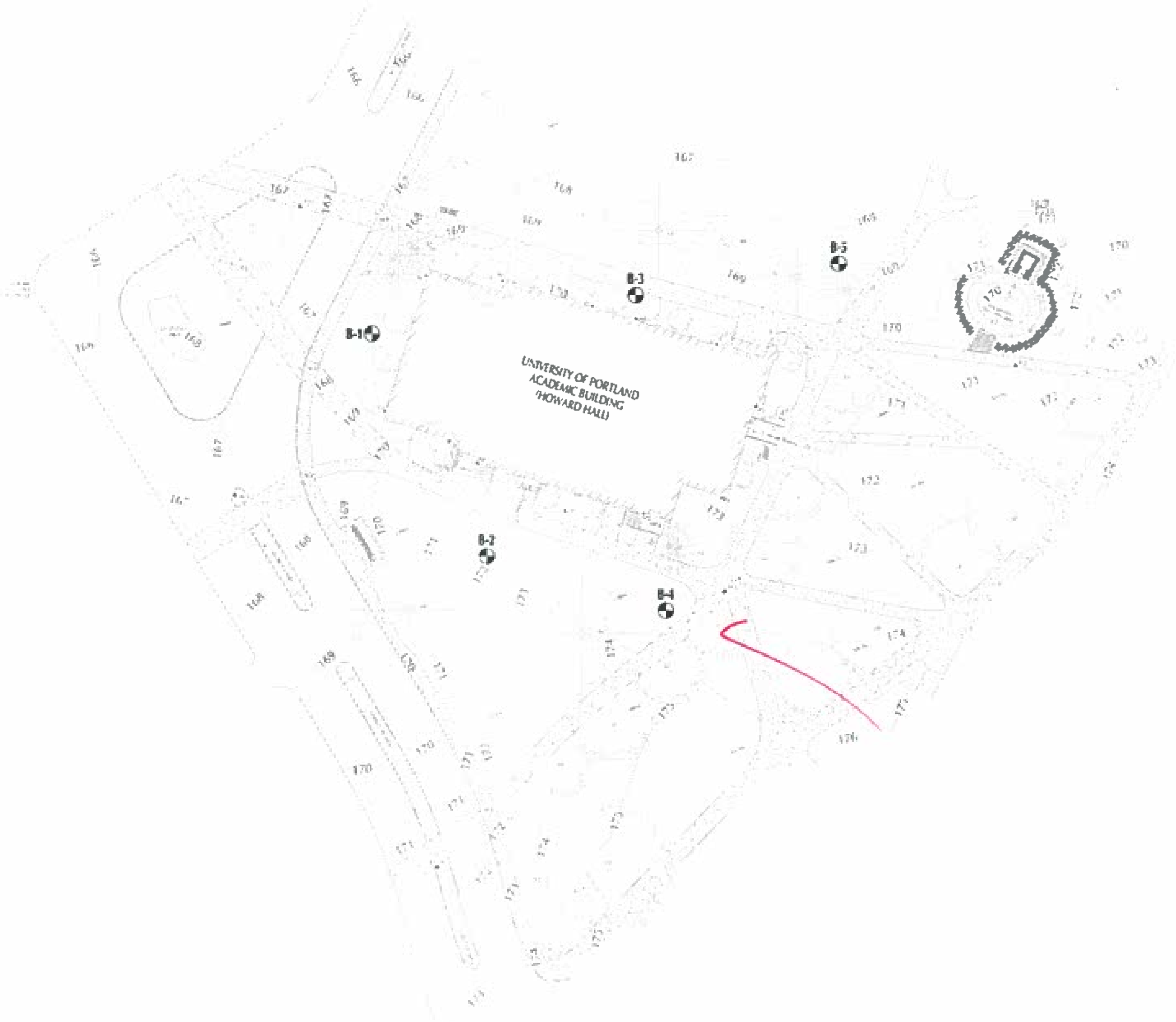


DATE /2019	DUNDON-BERCHTOLD HALL STRUCTURAL FRAMING PLAN	CLASSROOM BUILDING ROOF PLAN VIEW	S.4



3″
BOLT DIA. = 3/4″
PLATE THICKNESS = 3/8″
BOLT SPACING = 2 3/8″
W24x55
W40x183


W40X183
BOLT DIA. = 3/4"
PLATE THICKNESS = 1/4"
BOLT SPACING = 2 5/8"
W12x87



BORING COMPLETED BY GRI
(MAY 26 - JUNE 6, 2016)

SITE PLAN FROM FILE BY KPFF CONSULTING ENGINEERS, DATED JUNE 3, 2016

North

0 50 100 FT

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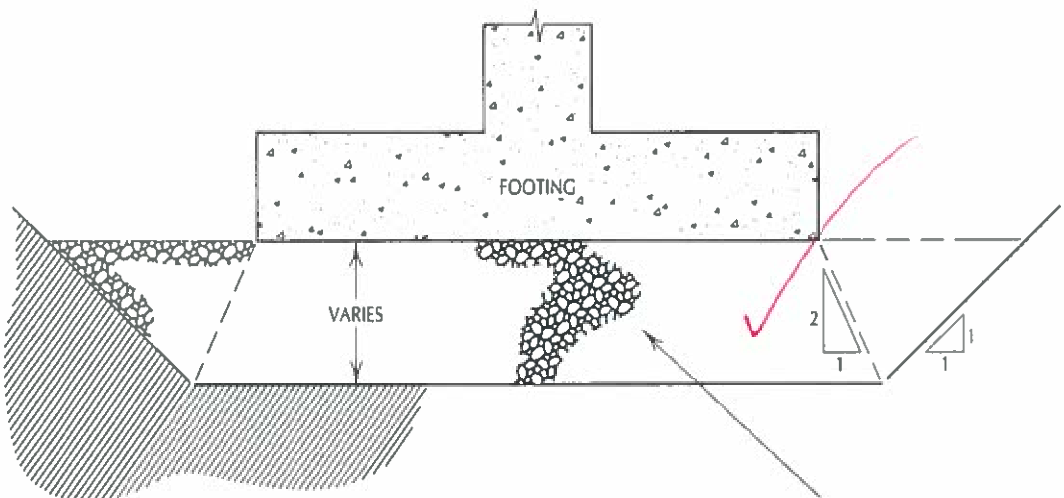
SITE PLAN

JUNE 2016 JOB NO. 5856 FIG. 2



NOT TO SCALE

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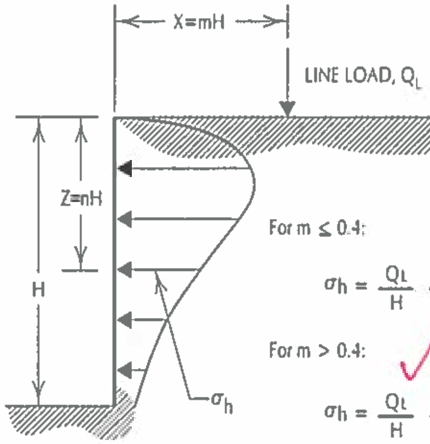
FOOTING OVEREXCAVATION DETAIL

JUNE 2016 JOB NO. 5856 FIG. 3



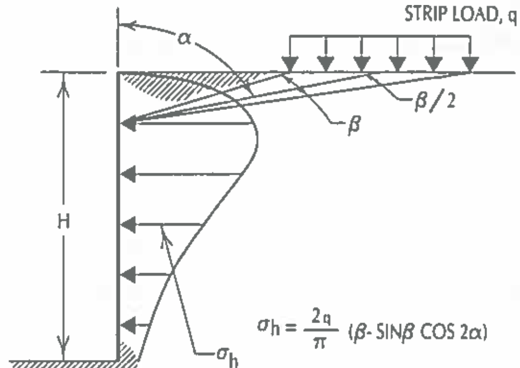
For m ≤ 0.4:

$$\sigma_h = \frac{Q_L}{H}\,\frac{0.2n}{(0.16+n^2)^2}$$

For m > 0.4:

$$\sigma_h = \frac{Q_L}{H}\,\frac{1.28m^2n}{(m^2+n^2)^2}$$

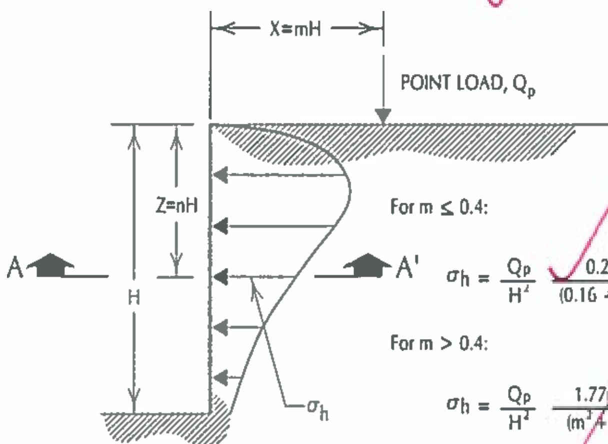
LINE LOAD PARALLEL TO WALL



$$\sigma_h = \frac{2q}{\pi}(\beta - \text{SIN}\beta\ \text{COS}\ 2\alpha)$$

(β in radians)

STRIP LOAD PARALLEL TO WALL

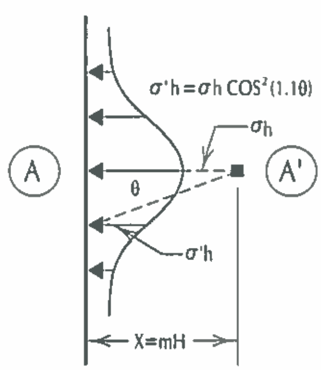


For m ≤ 0.4:

$$\sigma_h = \frac{Q_P}{H^2}\,\frac{0.28n^2}{(0.16+n^2)^3}$$

For m > 0.4:

$$\sigma_h = \frac{Q_P}{H^2}\,\frac{1.77m^2n^2}{(m^2+n^2)^3}$$



DISTRIBUTION OF HORIZONTAL PRESSURES

VERTICAL POINT LOAD

NOTES:

1. THESE GUIDELINES APPLY TO RIGID WALLS WITH POISSON'S RATIO ASSUMED TO BE 0.5 FOR BACKFILL MATERIALS.

2. LATERAL PRESSURES FROM ANY COMBINATION OF ABOVE LOADS MAY BE DETERMINED BY THE PRINCIPLE OF SUPERPOSITION.

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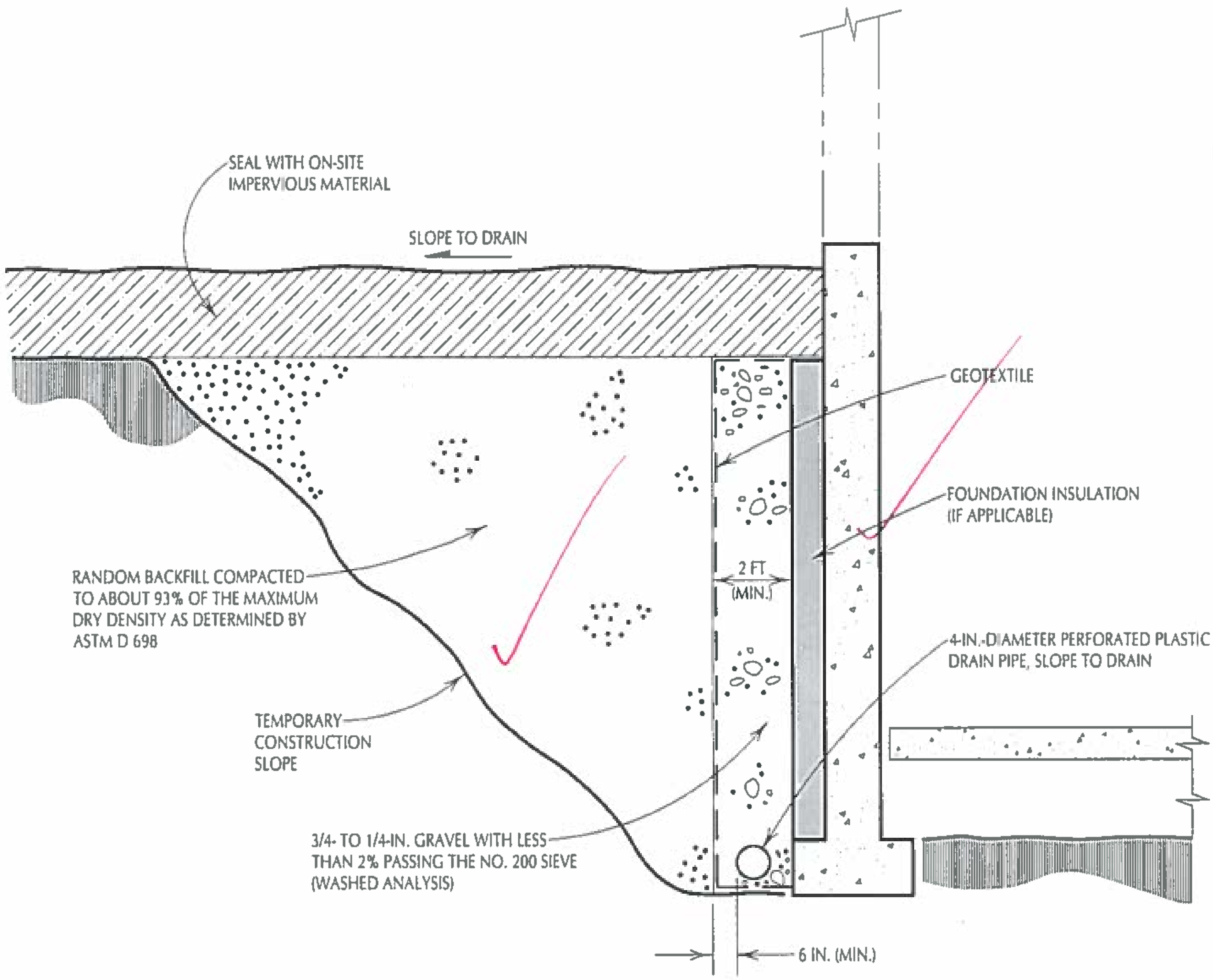
SURCHARGE-INDUCED LATERAL PRESSURE

JUNE 2016 | JOB NO. 5856 | FIG. 4



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TYPICAL SUBDRAINAGE DETAIL

JUNE 2016 | JOB NO. 5856 | FIG. 5

APPENDIX D

CALCULATIONS

Leily Mojarab

SNOW LOADS

$p_f = 0.7 C_e C_t I_s p_g = (0.7)(1.0)(1.0)(1.1)(11\ lb/ft^2) = 8.47\ lb/ft^2$

$p_s = C_s p_f = (0.62)(8.47\ lb/ft^2) = 5.25\ lb/ft^2$

$p_m =$ 20 psf + 5psf rain on snow load = 25 psf

↳ from OSSC

* Use $\boxed{\text{25 psf Snow Load}}$

Kyle Cadiz

Sample Beam Calculation

B5 - 18

$L = 40\,psf$

$D = 30.6\,psf + 4.6\,psf + 15\,psf + 15\,psf + 10\,psf$ 75.2 psf

Concrete 3½" slab; Steel deck 16/18 gauge PLB; Partitions; Ceiling; Seismic weight addition

Live load reduction: $A_T = (40.83)(6.84375) = 279.45\,ft^2$

$$L = L_o\left(0.25 + \frac{4.57}{\sqrt{K_{LL} A_T}}\right) = 40\left(0.25 + \frac{4.57}{\sqrt{2(279.45)}}\right) = 17.73\,psf \quad ??$$

$$1.2D + 1.6L = 1.2(75.2) + 1.6(17.73) = w_u = 118.61\,psf$$

$$w = 118.61\,psf\,(6.84375\,ft) = 811.74\,lb/ft$$

$$M_u = \frac{w_u \ell^2}{8} = \frac{(811.74\,lb/ft)(40.83\,ft)^2}{8} = 169155.34\,ft\text{-}lb = 169\,kip\text{-}ft$$

Select $\phi M_p = 177\,kip\text{-}ft > 169\,kip\text{-}ft$ ∴ OK $\Longrightarrow$ $\boxed{W14\times30}$

$V = 16{,}566\,lb = 16.6\,k < 112\,k$ ∴ OK

$$\Delta = \frac{5}{384}\frac{w\ell^4}{EI}$$

Roof Level Classroom Building

Beams

B1-4 & B7-10		B5 & B6							
Beam	W12x16	Beam	W12x16	Beam		Beam		Beam	
Length (ft)	6.85	Length (ft)	2	Length (ft)	10	Length (ft)		Length (ft)	
Moment of Inertia (in^4)	2.82	Moment of Inertia (in^4)	2.82	Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)	
Live Load	0	Live Load		Live Load		Live Load		Live Load	
Reduced Live Load	0	Reduced Live Load		Reduced Live Load		Reduced Live Load		Reduced Live Load	
Dead Load	559	Dead Load	Refer to she	Dead Load		Dead Load		Dead Load	
Moment	34.4	Moment	3.6	Moment		Moment		Moment	
Max Moment	75.4	Max Moment	75.4	Max Moment		Max Moment		Max Moment	
Shear	20	Shear	2.2	Shear		Shear		Shear	
Max Shear	79.2	Max Shear	79.2	Max Shear		Max Shear		Max Shear	
Deflection	0.000184	Deflection		Deflection		Deflection		Deflection	
Max Deflection	0.0388	Max Deflection		Max Deflection		Max Deflection		Max Deflection	

Beam		Beam		Beam		Beam		Beam	
Length (ft)		Length (ft)		Length (ft)		Length (ft)		Length (ft)	
Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)	
Live Load		Live Load		Live Load		Live Load		Live Load	
Reduced Live Load		Reduced Live Load		Reduced Live Load		Reduced Live Load		Reduced Live Load	
Dead Load		Dead Load		Dead Load		Dead Load		Dead Load	
Moment		Moment		Moment		Moment		Moment	
Max Moment		Max Moment		Max Moment		Max Moment		Max Moment	
Shear		Shear		Shear		Shear		Shear	
Max Shear		Max Shear		Max Shear		Max Shear		Max Shear	
Deflection		Deflection		Deflection		Deflection		Deflection	
Max Deflection		Max Deflection		Max Deflection		Max Deflection		Max Deflection	

2nd Floor Classroom Building

Beams

B1-4		B5-18		B19-28		B29-30		B31-34	
Beam	W21x50	Beam	W21x44	Beam	W12x14	Beam	W18x35	Beam	W12x19
Length (ft)	42.66	Length (ft)	40.83	Length (ft)	21.125	Length (ft)	42.66	Length (ft)	21.75
Moment of Inertia (in^4)	24.9	Moment of Inertia (in^4)	20.7	Moment of Inertia (in^4)	2.36	Moment of Inertia (in^4)	15.3	Moment of Inertia (in^4)	3.76
Live Load	80	Live Load	80	Live Load	40	Live Load	40	Live Load	60
Reduced Live Load	63.3	Reduced Live Load	70.8	Reduced Live Load	45.29	Reduced Live Load	35.4	Reduced Live Load	67.2
Dead Load	82.7	Dead Load	82.7	Dead Load	82.2	Dead Load	82.7	Dead Load	82.7
Moment	410.5	Moment	303	Moment	63.3	Moment	242	Moment	84
Max Moment	413	Max Moment	358	Max Moment	65.3	Max Moment	249	Max Moment	92.6
Shear		Shear	29.7	Shear	11.8	Shear		Shear	
Max Shear	237	Max Shear	317	Max Shear	64.3	Max Shear	159	Max Shear	86
Deflection	0.15	Deflection	0.09	Deflection	0.0004	Deflection	0.037	Deflection	0.0012
Max Deflection	0.237	Max Deflection	0.23	Max Deflection	0.117	Max Deflection	0.237	Max Deflection	0.12

B35		B36 and 40		B37 and 39		B38		B41	
Beam	W8x10	Beam	W8x10	Beam	W14x22	Beam	W24x55	Beam	W10x19
Length (ft)	12	Length (ft)	12.667	Length (ft)	20.2	Length (ft)	44.9	Length (ft)	21.75
Moment of Inertia (in^4)	2.09	Moment of Inertia (in^4)	2.09	Moment of Inertia (in^4)	7	Moment of Inertia (in^4)	29.1	Moment of Inertia (in^4)	4.29
Live Load	80	Live Load	80	Live Load	80	Live Load	100	Live Load	80
Reduced Live Load	128	Reduced Live Load	114	Reduced Live Load	81	Reduced Live Load	87	Reduced Live Load	95.4
Dead Load	82.7	Dead Load	82.7	Dead Load	82.7	Dead Load	82.7	Dead Load	82.7
Moment	31	Moment	30	Moment	113	Moment	393	Moment	79
Max Moment	32.9	Max Moment	32.9	Max Moment	125	Max Moment	503	Max Moment	83
Shear		Shear		Shear		Shear		Shear	
Max Shear	40.2	Max Shear	40.2	Max Shear	94.5	Max Shear	252	Max Shear	76.5
Deflection	8.90E-05	Deflection	0.00011	Deflection	0.001	Deflection	0.31	Deflection	0.0017
Max Deflection	0.067	Max Deflection	0.07	Max Deflection	0.112	Max Deflection	0.25	Max Deflection	0.12

1st Floor Classroom Building

Beams

B1-6		B7-12		B13-14		B15			
Beam	W24x55	Beam	W14x26	Beam	W14x22	Beam	W12x22	Beam	
Length (ft)	40.83	Length (ft)	26.5	Length (ft)	21.75	Length (ft)	21.75	Length (ft)	
Moment of Inertia (in^4)	29.1	Moment of Inertia (in^4)	8.91	Moment of Inertia (in^4)	7	Moment of Inertia (in^4)	4.66	Moment of Inertia (in^4)	
Live Load	80	Live Load	40	Live Load	60	Live Load	60	Live Load	
Reduced Live Load	61.3	Reduced Live Load	35.5	Reduced Live Load	57.2	Reduced Live Load	62	Reduced Live Load	
Dead Load	82.7	Dead Load	82.7	Dead Load	82.7	Dead Load	82.7	Dead Load	
Moment	430	Moment	144	Moment	118	Moment	96	Moment	
Max Moment	503	Max Moment	153	Max Moment	125	Max Moment	110	Max Moment	
Shear	42	Shear	23	Shear	22	Shear	23	Shear	
Max Shear	252	Max Shear	94.5	Max Shear	94.5	Max Shear	95.9	Max Shear	
Deflection	0.16	Deflection	0.005	Deflection	0.003	Deflection	0.002	Deflection	
Max Deflection	0.21	Max Deflection	0.15	Max Deflection	0.12	Max Deflection	0.12	Max Deflection	

Beam		Beam		Beam		Beam		Beam	
Length (ft)		Length (ft)		Length (ft)		Length (ft)		Length (ft)	
Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)	
Live Load		Live Load		Live Load		Live Load		Live Load	
Reduced Live Load		Reduced Live Load		Reduced Live Load		Reduced Live Load		Reduced Live Load	
Dead Load		Dead Load		Dead Load		Dead Load		Dead Load	
Moment		Moment		Moment		Moment		Moment	
Max Moment		Max Moment		Max Moment		Max Moment		Max Moment	
Shear		Shear		Shear		Shear		Shear	
Max Shear		Max Shear		Max Shear		Max Shear		Max Shear	
Deflection		Deflection		Deflection		Deflection		Deflection	
Max Deflection		Max Deflection		Max Deflection		Max Deflection		Max Deflection	

First and Second Level Signature Building

Beams

	B8	B9	B10	B11	B12	B13	B14		
Beam	W14x26	W21x44	W18x35	W12x26	W14x30	W16x31	W16x40		
Length (ft)	25	25	25	25	25	25	25		
Moment of Inertia (in^4)	19.6	20.7	15.3	17.3	19.6	12.4	28.9		
Live Load	100	100	100	100	100	100	100		
Reduced Live Load	114	74.8	88.4	107	96.48	92.08	79.77		
Dead Load	82.7	82.7	82.7	82.7	82.7	82.7	82.7		
Moment	140	310	211	135	168	193	266		
Max Moment	151	358	249	140	177	203	274		
Shear	21	50	34	22	27	31	41		
Max Shear	106	217	159	84.2	112	131	146		
Deflection	0.01888	0.0341	0.0184	0.0149	0.0195	1.99E-02	0.0421		
Max Deflection	0.13888	0.13888	0.13888	0.13888	0.13888	0.13888	0.13888		

Roof Level Signature Building

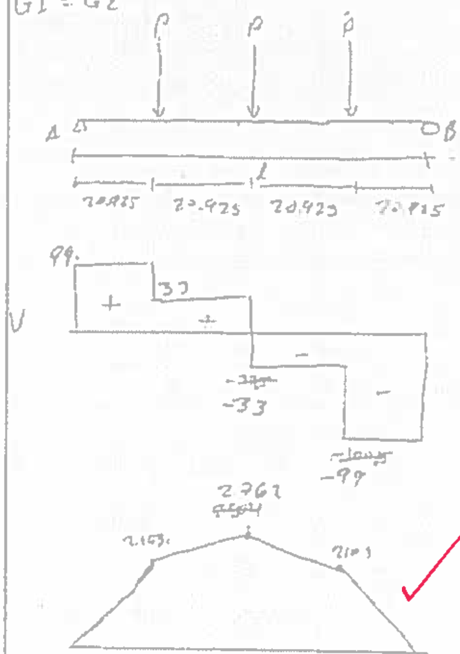
Beams

	B15	B16	B17	B18/19/20	B21	B22	B23	B24
Beam	W10x12	W12x19	W10x12	W10x12	W10x12	W10x12	W12x14	W12x19
Length (ft)	25	25	25	25	25	25	25	25
Moment of Inertia (in^4)	2.18	3.7	2.18	2.16	2.16	2.18	3.10	3.7
Live Load	0	0	0	0	0	0	0	0
Reduced Live Load	0	0	0	0	0	0	0	0
Dead Load	62.7	62.7	62.7	62.7	62.7	62.7	62.7	62.7
Moment	41	84	44	36	27	37	59	89
Max Moment	46.9	92.6	46.9	46.9	46.9	46.9	65.3	92.6
Shear	7	14	8	4	5	6	10	15
Max Shear	56.3	86	56.3	56.3	56.3	56.3	64.3	86
Deflection	0.0011	0.0048	0.0013	0.0013	0.0013	1.30E-03	0.0021	0.0048
Max Deflection	0.13888	0.13888	0.13888	0.13888	0.13888	0.13888	0.13888	0.13888

Kyle Cadiz

Classroom First Floor

G1 = G2



$P = 42000\text{ lb} + 551\text{ lb/ft}(40.83/2\text{ ft}) + 22000\text{ lb} + 261\text{ lb/ft}(26.5/2\text{ ft})$

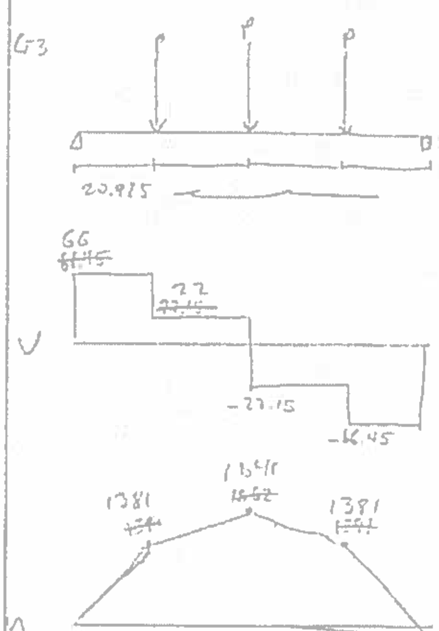
$P = 65467 = 66\text{ k}$

$\frac{66 \times 3}{2} = 99\text{ k}$ at A and B

Max Shear = 99

Max Moment = ~~2804~~ 2763

G3



$P = 42000\text{ lb} + 551\text{ lb/ft}(40.83/2\text{ ft}) = 44$

$\frac{44 \times 3}{2} = 66$ at A and B

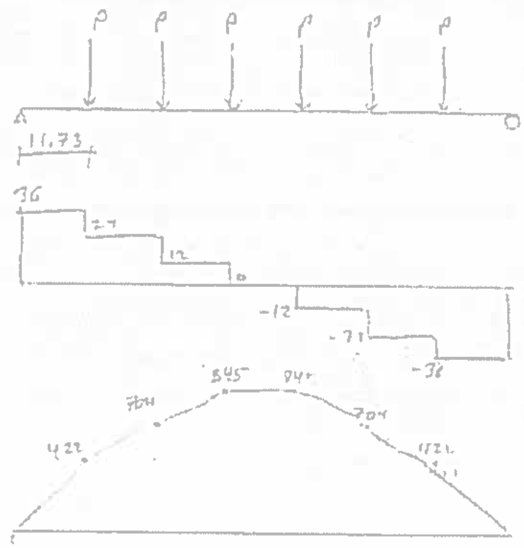
Max Shear = 66 k

Max Moment = ~~1662 k~~ 1541 k

Kyle Cadiz

Classroom Second Floor

G1



$P = 1180\text{lb} + 14\,\text{lb/ft}\,(21.125/2\ \text{ft}) = 1197.7 = 12\text{k}$

$\frac{12 \times 6}{2} = 36\text{k}$ at A and B

$\ell = 67.125$

Max Shear = 36k

Max Moment = 845 k-ft

G2 and G3

$P = 1180\text{lb} + 14\,\text{lb/ft}\,(21.125/2\ \text{ft}) = 12\text{k}$

$\frac{12}{2} = 6\text{k}$ @ A and B

$\ell = 27.375$

Max Shear = 6 k

Max Moment = 82.125 k-ft

Kyle Cadiz

2nd Floor G4-5

$P_1 = 11.8k + 29.7k + (44 \times (40.83/2)) + (14 \times (21.125/2))$
$= 42.5$

$\Sigma M_B = 0$

$42.5(20.55) + 42.5(13.7) + 42.5(6.85) - R_A(27.4) = 0$

$R_A = 63.75$

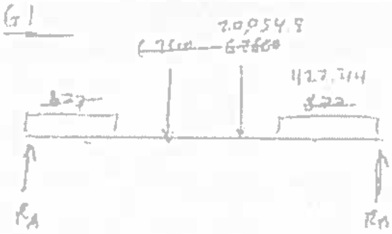
$R_B = 63.75$ Max Shear $= 63.75k$

Max Moment = 582 ft-k

Kyle Cadiz

Classroom Bldg. Roof

G1



~~2 × 31,300 + (16.15 × 2.5 ft) = 62,656~~

~~7' × 6 2.7 psf = 277.5 lb/ft~~

$20{,}000 + (16 \times \frac{6.55}{2}) = 20{,}054.8$

$6.85' \times 62.7 psf = 427.44$ lb/ft

$R_A = R_B = 30k$

$M = 462$ ft·k

G2-4

Same as G1 except for point load

$2 \times 20{,}000 + (16.15 \times 6.55) = 40109.6$

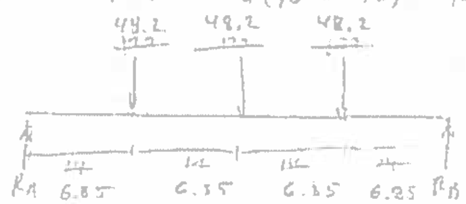
G5

Same as G4 except for point load

$20000 + 22000 + (16 \times 6.85) = 42109.6$

G6-7

$P = G2-4 = 46000 + (90 \times 57.5/2) = 48{,}262.5 = 48.4k$

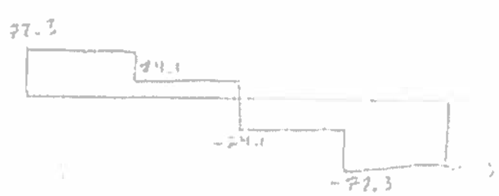


$\Sigma M_B = 0$

$48.2(20.55) + 48.2(13.7) + 48.2(6.85) - R_A(27.4) = 0$

$R_A = 72.3k$

$R_B = 72.3k$



Max Shear = ~~153k~~ 72.3k

Max Moment = ~~3445~~ 660.34 ft·k

Roof Level Classroom Building		Height		14.67															
Columns																			
C1		C2		C3		C4		C5		C6		C7		C8					
Column	W12x87	Column	W12x87	Column	W12x87	Column	W12x87	Column	W12x87	Column	W12x87	Column	W12x87	Column	W12x87	Beam		Beam	
Length (ft)	14.67	Length (ft)	14.67	Length (ft)		Length (ft)		Length (ft)		Length (ft)		Length (ft)		Length (ft)		Length (ft)		Length (ft)	
Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)	
Tributary Area	703	Tributary Area	703	Tributary Area	461.4	Tributary Area	461.4	Tributary Area	225.1	Tributary Area	580.5	Tributary Area	916	Tributary Area	928				
Live Load	0	Live Load	0	Live Load	0	Live Load	0	Live Load	0	Live Load	0	Live Load	0	Live Load	0	Live Load		Live Load	
Reduced Live Load	0	Reduced Live Load	0	Reduced Live Load	0	Reduced Live Load	0	Reduced Live Load	0	Reduced Live Load	0	Reduced Live Load	0	Reduced Live Load	0	Reduced Live Load		Reduced Live Load	
Dead Load	62.4	Dead Load	62.4	Dead Load	62.4	Dead Load	62.4	Dead Load	62.4	Dead Load	62.4	Dead Load	62.4	Dead Load	62.4	Dead Load		Dead Load	
Snow Load	25	Snow Load	25	Snow Load	25	Snow Load	25	Snow Load	25	Snow Load	25	Snow Load	25	Snow Load	25				
Combined Load (16-2)	87.38	Combined Load (16-2)	87.38	Combined Load (16-2)	87.38	Combined Load (16-2)	87.38	Combined Load (16-2)	87.38	Combined Load (16-2)	87.38	Combined Load (16-2)	87.38	Combined Load (16-2)	87.38				
Combined Load (16-3)	114.88	Combined Load (16-3)	114.88	Combined Load (16-3)	114.88	Combined Load (16-3)	114.88	Combined Load (16-3)	114.88	Combined Load (16-3)	114.88	Combined Load (16-3)	114.88	Combined Load (16-3)	114.88				
Combined Load (Controls)	114.88	Combined Load (Controls)	116.48	Combined Load (Controls)	118.08	Combined Load (Controls)	119.68	Combined Load (Controls)	121.28	Combined Load (Controls)		Combined Load (Controls)	124.48	Combined Load (Controls)	126.08				
G1 (Kips)	32.3625	G3	32.3625	G7	73.3412	G6	73.3412	G9	21.21	G1		G5	50.3625	G5	50.3625				
G7 (Kips)	73.3412	G6	73.3412	G12	21.21	G9	21.21	G12	21.21	G2		G7	73.3412	G8	73.3412				
										G3		G11	5.965	G10	5.965				
										G4									
Loading (Kips/sq ft)	80.75064	Loading	81.88544	Loading	54.482112	Loading	55.220152	Loading	27.800118	Loading	0	Loading	324.01368	Loading	115.48923				
Point Load (Kips)	186.66434	Point Load	187.58914	Point Load	189.033312	Point Load	189.773552	Point Load	69.720128	Point Load	0	Point Load	243.69238	Point Load	245.15798	Moment		Moment	
Max Point Load	865	Max Point Load	865	Max Point Load	865	Max Point Load	865	Max Point Load	865	Max Point Load		Max Point Load	865	Max Point Load	865	Max Moment		Max Moment	

2nd Floor Classroom Building		Height		16															
Columns																			
C1		C2		C3		C4		C7		C8									
Column	W12x87	Column	W12x87	Column	W12x87	Column	W12x87	Column	W12x87	Column	W12x87	Column		Column		Beam		Beam	
Length (ft)		Length (ft)		Length (ft)		Length (ft)		Length (ft)		Length (ft)		Length (ft)		Length (ft)		Length (ft)		Length (ft)	
Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)	
Tributary Area	703	Tributary Area	703	Tributary Area	461.4	Tributary Area	461.4	Tributary Area	916	Tributary Area	916	Tributary Area	703	Tributary Area	703				
Live Load	100	Live Load	100	Live Load	80	Live Load	80	Live Load	80	Live Load	80	Live Load	0	Live Load	0	Live Load		Live Load	
Reduced Live Load	Too big	Reduced Live Load	Too big	Reduced Live Load	Too big	Reduced Live Load	Too big	Reduced Live Load	Too big	Reduced Live Load	Too big	Reduced Live Load	0	Reduced Live Load	0	Reduced Live Load		Reduced Live Load	
Dead Load	82.7	Dead Load	82.7	Dead Load	82.7	Dead Load	82.7	Dead Load	82.7	Dead Load	82.7	Dead Load	82.7	Dead Load	82.7	Dead Load		Dead Load	
Snow Load	25	Snow Load	25	Snow Load	25	Snow Load	25	Snow Load	25	Snow Load	25	Snow Load	25	Snow Load	25				
Combined Load (16-2)	271.74	Combined Load (16-2)	271.74	Combined Load (16-2)	239.74	Combined Load (16-2)	239.74	Combined Load (16-2)	239.74	Combined Load (16-2)	239.74	Combined Load (16-2)	111.74	Combined Load (16-2)	111.74				
Combined Load (16-3)	139.24	Combined Load (16-3)	139.24	Combined Load (16-3)	139.24	Combined Load (16-3)	139.24	Combined Load (16-3)	139.24	Combined Load (16-3)	139.24	Combined Load (16-3)	139.24	Combined Load (16-3)	139.24				
Combined Load (Controls)	267.38	Combined Load (Controls)	115.88	Combined Load (Controls)	116.88	Combined Load (Controls)	117.88	Combined Load (Controls)	118.88	Combined Load (Controls)	119.68	Combined Load (Controls)	120.88	Combined Load (Controls)	121.88				
G6 (Kips)	62.59875	G6	62.59875	G3	6.2600625	G2	6.2600625	G3	6.2600625	G2	6.2600625	G1		G1					
G4 (Kips)	64.6816	G5	64.6816					G4	64.6816	G5	64.6816	G2		G2					
												G3		G3					
Previous Load	186.66434	Previous Load	187.58914	Previous Load	189.033312	Previous Load	189.773552	Previous Load	243.69238	Previous Load	245.15798	G4		G4					
Loading (Kips/sq ft)	176.90814	Loading	81.96364	Loading	53.928432	Loading	54.389832	Loading	108.89408	Loading	109.83008	Loading		Loading					
Weight of Upper Column (Kips)	1.27629	Weight of Upper Column (	1.27629	Weight of Upper Column	1.27629	Weight of Upper Column (	1.27629	Weight of Upper Column (	10.07829	Weight of Upper Column (	1.27629	Weight of Upper Column (	1.27629	Weight of Upper Column (	0.98289				
Point Load (Kips)	488.92917	Point Load	397.60942	Point Load	210.9980965	Point Load	211.697737	Point Load	437.606413	Point Load	427.186013	Point Load	1.27629	Point Load	0.98289	Moment		Moment	
Max Point Load	865	Max Point Load	865	Max Point Load	865	Max Point Load	865	Max Point Load	865	Max Point Load	865	Max Point Load		Max Point Load		Max Moment		Max Moment	

1st Floor Classroom Building		Height		16													
Columns																	
C1		C2		C7		C8											
Column	W12x87	Column	W12x87	Column	W12x87	Column	W12x87	Column		Column		Column		Column		Beam	
Length (ft)		Length (ft)		Length (ft)		Length (ft)		Length (ft)		Length (ft)		Length (ft)		Length (ft)		Length (ft)	
Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)	
Tributary Area	703	Tributary Area	703	Tributary Area	916	Tributary Area	916	Tributary Area		Tributary Area	703	Tributary Area	703	Tributary Area	703		
Live Load	80	Live Load	80	Live Load	80	Live Load	80	Live Load		Live Load	0	Live Load	0	Live Load	0	Live Load	
Reduced Live Load	133.704257	Reduced Live Load	0	Reduced Live Load	0	Reduced Live Load	0	Reduced Live Load		Reduced Live Load	0	Reduced Live Load	0	Reduced Live Load	0	Reduced Live Load	
Dead Load	82.7	Dead Load	82.7	Dead Load	82.7	Dead Load	82.7	Dead Load		Dead Load	62.4	Dead Load	62.4	Dead Load	62.4	Dead Load	
Snow Load	25	Snow Load	25	Snow Load	25	Snow Load	25	Snow Load		Snow Load	25	Snow Load	25	Snow Load	25		
Combined Load (16-2)	239.74	Combined Load (16-2)	239.74	Combined Load (16-2)	239.74	Combined Load (16-2)	239.74	Combined Load (16-2)		Combined Load (16-2)	87.38	Combined Load (16-2)	87.38	Combined Load (16-2)	87.38		
Combined Load (16-3)	139.24	Combined Load (16-3)	139.24	Combined Load (16-3)	139.24	Combined Load (16-3)	139.24	Combined Load (16-3)		Combined Load (16-3)	114.88	Combined Load (16-3)	114.88	Combined Load (16-3)	114.88		
Combined Load (Controls)	247.38	Combined Load (Controls)	115.88	Combined Load (Controls)	116.88	Combined Load (Controls)	117.88	Combined Load (Controls)		Combined Load (Controls)	119.88	Combined Load (Controls)	120.88	Combined Load (Controls)	121.88		
G1	106.65855	G2	106.65855	G3	106.65855	G2	106.65855	G1		G1		G1					
		W14x26	22.3441			W12x26	22.3441	G2		G2		G2					
		W24x55	43.122825			W24x55	43.122825	G3		G3		G3					
								G4		G4		G4					
Previous Load	488.92917	Previous Load	397.60942	Previous Load	433.6064125	Previous Load	427.18403										
Loading	173.90814	Loading	81.96364	Loading	107.06208	Loading	107.97808	Loading		Loading		Loading					
Weight of Upper Column	1.392	Weight of Upper Column	1.392	Weight of Upper Column	1.392	Weight of Upper Column	1.392	Weight of Upper Column		Weight of Upper Column		Weight of Upper Column					
Point Load	770.88783	Point Load	652.590935	Point Load	648.7190475	Point Load	708.681968	Point Load		Point Load	0	Point Load	0	Moment	0		
Max Point Load	865	Max Point Load	865	Max Point Load	865	Max Point Load	865	Max Point Load		Max Point Load		Max Point Load		Max Moment			

Column Summary			
Ground to Roof Level	Load	Max Load	Member
C1	770.88781	865	W12x87
C2	652.590935	865	W12x87
C3	210.498097	865	W12x87
C4	211.697737	865	W12x87
C5	89.720118	865	W12x87
C6	94.30512	865	W12x87
C7	648.719041	865	W12x87
C8	708.681964	865	W12x87

Footings						
Column	Height	B/R of height	Weight	Loading	Soil Bearing Pressure (psf)	Footing Area (sqft)
C1	45.67	87	3973.29	770887.81	2500	308.36
C2	45.67	87	3973.29	652590.94	2500	261.04
C3	45.67	87	3973.29	210498.10	2500	84.20
C4	45.67	87	3973.29	211697.74	2500	84.68
C5	45.67	87	3973.29	94305.12	2500	37.73
C6	45.67	87	3973.29	69720.13	2500	27.89
C7	45.67	87	3973.29	648719.04	2500	259.49
C8	45.67	87	3973.29	708681.97	2500	283.47

2nd Floor Classroom Building Girders			
Highlest Load Girder		**All other lower girders**	
Beam	**W40x149**	Beam	**W21x44**
Length (ft)	**66.083**	Length (ft)	
Moment of Inertia (in^4)		Moment of Inertia (in^4)	
P1		P1	12
-			
P6			
Moment	2001	Moment	305
Max Moment	2240	Max Moment	358
Shear	86.5	Shear	30.55
Max Shear	650	Max Shear	217
Deflection		Deflection	
Max Deflection		Max Deflection	

Kyle Cadiz

Roof Beams and Girders

B1 - 4 and B7 - 10

$L = 6.85$

A_T Width = $(2 \times 5.25) = 10.5'$

$A_T = 71.925$

B1 - 10 Support AHU (27 k)

Neglect B5 and B6 for support

- Only B1-4 and B7-10 will support

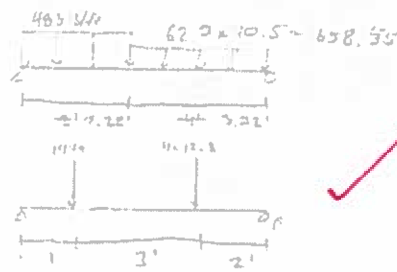
$\frac{27\ k}{8} = 3.375\ k/\text{Beam} = \frac{3375\ lb/\text{Beam}}{7\ ft/\text{Beam}} = 483\ lb/ft/\text{beam}$

Also supporting slab dead load

$D = 2.3\ psf + 60.4\ psf = 62.7$

Combined load = $1.2D + 0 + 483$

B5 and B6



Roof Level Classroom Building

Girders

G1	
Beam	W30x90
Length (ft)	52.5
Moment of Inertia (in^4)	
P1	20.1
P2	20.1
Distributed Loads	427.44
Moment	462
Max Moment	1060
Shear	16
Max Shear	374
Deflection	
Max Deflection	0.29166667

G2-4	
Beam	W30x90
Length (ft)	52.5
Moment of Inertia (in^4)	
P1	40.1
P2	40.1
Distributed Loads	427.44
Moment	883
Max Moment	1060
Shear	46
Max Shear	374
Deflection	
Max Deflection	0.29166667

G5	
Beam	W30x90
Length (ft)	52.5
Moment of Inertia (in^4)	
P1	42.1
P2	42.1
*calculated in B5 6	
Distributed Loads	427.44
Moment	924.7
Max Moment	1060
Shear	44
Max Shear	374
Deflection	
Max Deflection	

G6-7	
Beam	W24x76
Length (ft)	27.4
Moment of Inertia (in^4)	
P1	48.2
P2	48.2
P3	48.2
Moment	660.3
Max Moment	750
Shear	72.3
Max Shear	315
Deflection	
Max Deflection	

G8	
Beam	W21x44
Length (ft)	52.5
Moment of Inertia (in^4)	
P1	2.2
P2	2.2
Distributed Load	373
Moment	319
Max Moment	358
Shear	23
Max Shear	217
Deflection	
Max Deflection	

G9 & G12	
Beam	W12x16
Length (ft)	28.25
Moment of Inertia (in^4)	
Live Load	0
Reduced Live Load	6
Dead Load	62.4
Moment	68
Max Moment	755.4
Shear	
Max Shear	79.2
Deflection	
Max Deflection	

G10-11	
Beam	W10x12
Length (ft)	12.5
Moment of Inertia (in^4)	
P1	1.178
Moment	5.7
Max Moment	46.9
Shear	5.89
Max Shear	56.3
Deflection	
Max Deflection	

Beam		Beam		Beam	
Length (ft)		Length (ft)		Length (ft)	
Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)	
Live Load		Live Load		Live Load	
Reduced Live Load		Reduced Live Load		Reduced Live Load	
Dead Load		Dead Load		Dead Load	
Moment		Moment		Moment	
Max Moment		Max Moment		Max Moment	
Shear		Shear		Shear	
Max Shear		Max Shear		Max Shear	
Deflection		Deflection		Deflection	
Max Deflection		Max Deflection		Max Deflection	

Check with RISA

2nd Floor Classroom Building

Girders

G1	
Beam	W27x84
Length (ft)	82.125
Moment of Inertia (in^4)	
P1	12
P4	12
Moment	845
Max Moment	915
Shear	36
Max Shear	368
Deflection	
Max Deflection	

G2 and G3	
Beam	W12x19
Length (ft)	27.375
Moment of Inertia (in^4)	
P1	12
Moment	82.125
Max Moment	92.6
Shear	6
Max Shear	86
Deflection	
Max Deflection	

G4&5	
Beam	W21x68
Length (ft)	27.4
Moment of Inertia (in^4)	
P1	
P2	
P3	
Moment	582
Max Moment	600
Shear	63.75
Max Shear	272
Deflection	
Max Deflection	

G6	
Beam	W30x99
Length (ft)	52.5
Moment of Inertia (in^4)	
Live Load	100
Reduced Live Load	80.9
Dead Load	82.7
P1	6
Moment	1013
Max Moment	1170
Shear	60
Max Shear	463
Deflection	
Max Deflection	

Beam		Beam		Beam		Beam		Beam		Beam	
Length (ft)		Length (ft)		Length (ft)		Length (ft)		Length (ft)		Length (ft)	
Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)	
Live Load		Live Load		Live Load		Live Load		Live Load		Live Load	
Reduced Live Load		Reduced Live Load		Reduced Live Load		Reduced Live Load		Reduced Live Load		Reduced Live Load	
Dead Load		Dead Load		Dead Load		Dead Load		Dead Load		Dead Load	
Moment		Moment		Moment		Moment		Moment		Moment	
Max Moment		Max Moment		Max Moment		Max Moment		Max Moment		Max Moment	
Shear		Shear		Shear		Shear		Shear		Shear	
Max Shear		Max Shear		Max Shear		Max Shear		Max Shear		Max Shear	
Deflection		Deflection		Deflection		Deflection		Deflection		Deflection	
Max Deflection		Max Deflection		Max Deflection		Max Deflection		Max Deflection		Max Deflection	

1st Floor Classroom Building

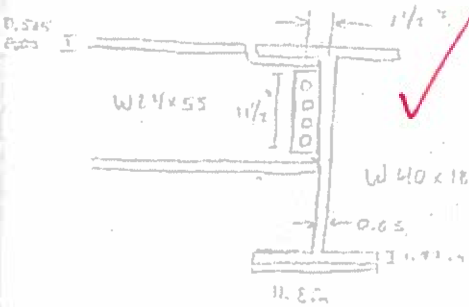
Girders

G1 and G2	
Girder	W40x183
Length (ft)	83.7
Moment of Inertia (in^4)	
P1	67
P2	67
P3	67
Moment	2776.3
Max Moment	2900
Shear	99
Max Shear	761
Deflection	
Max Deflection	0.465

G3	
Beam	W30x148
Length (ft)	83.7
Moment of Inertia (in^4)	
P1	44.3
P2	44.3
P3	44.3
Moment	1841
Max Moment	1880
Shear	66
Max Shear	599
Deflection	
Max Deflection	

Beam		Beam		Beam		Beam		Beam		Beam		Beam		Beam	
Length (ft)		Length (ft)		Length (ft)		Length (ft)		Length (ft)		Length (ft)		Length (ft)		Length (ft)	
Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)		Moment of Inertia (in^4)	
Live Load		Live Load		Live Load		Live Load		Live Load		Live Load		Live Load		Live Load	
Reduced Live Load		Reduced Live Load		Reduced Live Load		Reduced Live Load		Reduced Live Load		Reduced Live Load		Reduced Live Load		Reduced Live Load	
Dead Load		Dead Load		Dead Load		Dead Load		Dead Load		Dead Load		Dead Load		Dead Load	
Moment		Moment		Moment		Moment		Moment		Moment		Moment		Moment	
Max Moment		Max Moment		Max Moment		Max Moment		Max Moment		Max Moment		Max Moment		Max Moment	
Shear		Shear		Shear		Shear		Shear		Shear		Shear		Shear	
Max Shear		Max Shear		Max Shear		Max Shear		Max Shear		Max Shear		Max Shear		Max Shear	
Deflection		Deflection		Deflection		Deflection		Deflection		Deflection		Deflection		Deflection	
Max Deflection		Max Deflection		Max Deflection		Max Deflection		Max Deflection		Max Deflection		Max Deflection		Max Deflection	

Kyle Cadiz



Shear = 42 kip

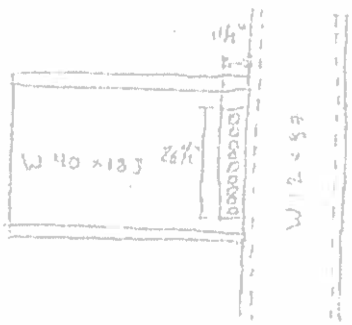
$n = 4$ bolts (Group A - STD) $d = 3/4$ in

Include thread

Plate thickness = 3/8 in

Max shear = 62.5 kip

$L = 11\ 1/2"$



Shear = 99 kips

$n = 9$ bolts (Group A - STD) $d = 3/4$ in

Include thread

Plate thickness = 1/4"

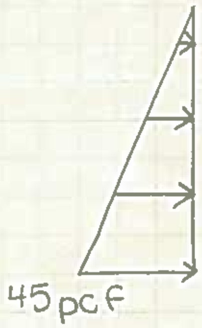
Max Shear = 114 kips

$L = 26\ 1/2$

Leily Majarab

Basement Wall

① Soil Pressure



16 ft and 19 ft heights

(45 pcf)(1 ft unit width)(16 ft) = $\boxed{720 \text{ lb/ft}}$

(45 pcf)(1 ft unit width)(19 ft) = $\boxed{855 \text{ lb/ft}}$

② Seismic Loading

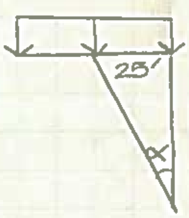
= 10H from geotech report

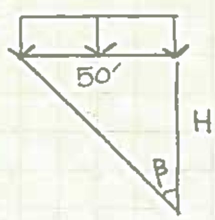
$10(16 \text{ ft}) = \boxed{160 \text{ lb/ft}}$

$10(19 \text{ ft}) = \boxed{190 \text{ lb/ft}}$

③ Surcharge loading

*equations from geotech report





$\alpha = \tan^{-1}\left(\frac{25 \text{ ft}}{H}\right)$

$\beta = \tan^{-1}\left(\frac{50 \text{ ft}}{H}\right)$

$\sigma_h = \frac{2q}{\pi}(\beta - \sin\beta\cos\alpha)$ *q = 100 psf

i) $\alpha = 1.001$, $\beta = 1.261$

$\sigma_h = \frac{2(100 \text{ psf})}{\pi}[1.261 - \sin(1.261)\cos(1.001)] = 47.6 \text{ lb/ft}$

Leily Mojarab

Basement wall

ii) $\alpha = 0.921$, $\beta = 1.208$

$$\sigma_h = \frac{2(100\,psf)}{\pi}\left[1.208 - \sin(1.208)\cos(0.921)\right] = 40.9\ lb/ft$$

④ Total Load

i) Basement (16ft height)

$$(720 + 160 + 47.6)\ lb/ft = \boxed{927.6\ lb/ft}$$

ii) Auditorium (19 ft height)

$$(855 + 190 + 40.9)\ lb/ft = \boxed{1085.9\ lb/ft}$$

APPENDIX E

ORIGINAL PROGRESS MEMORANDUMS

CE 484 – Progress Memorandum Grading Rubric – Spring 2019

Group # 4

10/10

Student Names:
1. John Black
2. Kyle Cadiz
3. Sofia Martinez
4. Leily Mojarab Author

Academic Advisor: Dr. Mehmet Inan
Project Title: **Sundon Berchtold Hall (Academic Building Design), Portland, OR**

Detailed, Thorough	Vague, Incomplete, Confusing	Wrong, Missing	Item
✓			Accomplishments since the previous memorandum: * a) What have you accomplished? b) What have you learned & what challenges have you faced? c) What persons have you contacted? d) What resources have you used? e) What have you concluded?
✓			Compare your progress with your Gantt Chart prepared in CE 483 in Fall 2018
✓			Tasks to be completed by individual members during the next period (To be specified for each member)
✓			Summary of time spent by individual members since previous Progress Memorandum (Table of billable items)
✓			Name of the primary author of the memorandum

*** To be written in text form (not bullets)**

January 23, 2019

U:admin/EGRsec/Mehmet/CE/484(was482)/ProgressMemorandum_Master

CE 484 **PROGRESS MEMORANDUM** Spring 2019

Group# 4 Project Name: Dundon-Berchtold Hall (Academic Building Design)
Academic Advisor's Name: Dr. Mehmet Inan
Industrial Advisor's Name: Aaron Wegner, KPFF; Andrew Burke, Soderstrom; Kevin Kelly, Fortis
Due Date: February 1, 2019

(3%) 1. ACCOMPLISHMENTS SINCE THE LAST MEMORANDUM & PROBLEMS ENCOUNTERED

a) What have you accomplished?

We met as a group to begin preliminary layouts for columns, girders, and beams. We have also split up into two teams where one team focuses on gravity loads and the other begins research for calculating lateral loads. As a group we have met with Mr. Aaron Wegner to bring him our materials and discuss our calculation of gravity and lateral loads, our initial column and beam layout design, and what our next step for this project is. We have taken these same materials to Dr. Inan and to Dr. Kuhn for feedback.

b) What have you learned and what challenges have you faced?

We have learned about how to calculate dead loads, live loads, snow loads, and wind loads. We have also learned about how to begin a column and beam layout on architectural plans. It has been a challenge for us to look at plans and take in small details, while not becoming overwhelmed by the amount of information presented in plans, especially when at the moment, we are not working with full scale printouts of the drawings. It has also been a challenge to navigate through different pages of the plans when some pages do not present the information we are looking for.

c) What persons have you contacted?

We have contacted all of our industry advisors; from KPFF, Mr. Aaron Wegner, from Fortis Construction, Mr. Kevin Kelly, and from Soderstrom Architects, Mr. Andrew Burke. We have also contacted Dr. Kuhn as a resource to guide us in steel design.

d) What resources have you used?

We have used the ASCE 7 (Minimum Design Loads and Associated Criteria for Buildings and Other Structures), Steel Design Manual, and Oregon Structural Specialty Code. We have also used Dr. Kuhn as a resource for steel design.

e) What have you concluded?

We have concluded that splitting up into teams to work on different aspects of the design, rather than one aspect at a time as a group, will be more efficient. We have also concluded that we will not be designing an entire lateral force resistance system for the building, per advice from our industry advisor, Mr. Aaron Wegner. We have also concluded that we will be designing the whole building's structural system, rather than the signature building's only.

Move this to the top of the next page

(2%) 2. COMPARE YOUR PROGRESS WITH YOUR GANTT CHART PREPARED IN CE 483 FALL ~~2017~~ 2018 My mistake, Will be corrected on the revised format on Moodle .. Sorry

We are in the phase of determining our load cases. We are a little bit ahead of schedule in this task because were supposed to have started this step January 21, and we began diving into this task January 18. We have begun to stray from our original master plan because we are focusing solely on steel design, rather than an alternative for each material. This is due to time constraints and our semester 1 research, which we believe is sufficient evidence for choosing steel as a material.

(2%) 3. TASKS TO BE COMPLETED BY INDIVIDUAL MEMBERS DURING THE NEXT PERIOD (TO BE SPECIFIED FOR EACH MEMBER)

Leily will be looking on the plans in order to determine floor finishing dead loads for the building per the ASCE 7. Kyle will be finding the dead loads of the exterior skin of the building. Sofia will conduct research and calculate dead loads for furniture that will be used in the building. John will determine the roof loads for the building.

(2%) 4. SUMMARY OF THE TIME SPENT BY INDIVIDUAL MEMBERS SINCE PREVIOUS MEMORANDUM (TABLE OF BILLABLE HOURS)

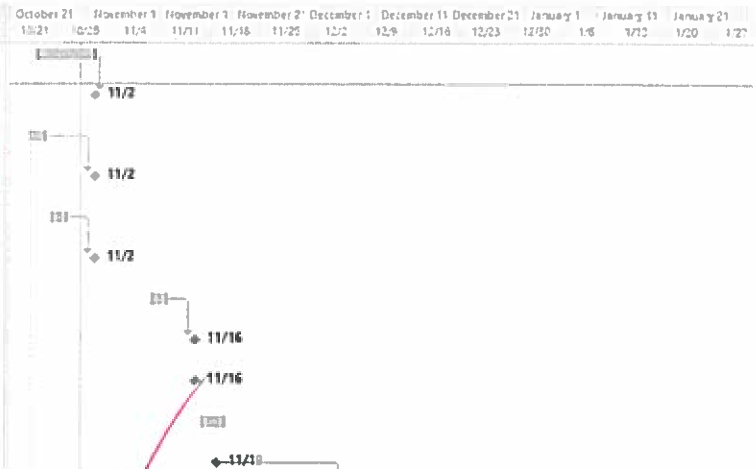
Name	Team Meetings (hrs)	Individual Tasks (hrs)	Task Descriptions	Total Hours
Kyle Cadiz	8.5	6	Determining dead loads, determining live loads, column layout	14.5
Leily Mojarab	8.5	4	Determining snow loads, dead loads, column layout	12.5
John Black	8	3	Studying wind loads, column layout	11
Sofia Martinez	8.5	2	Studying seismic loads, column layout	10.5

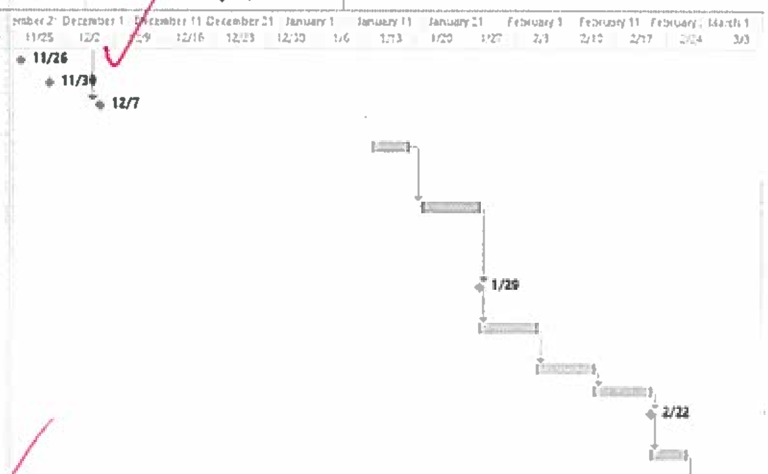
(1%) 5. NAME OF THE PRIMARY AUTHOR OF MEMORANDUM

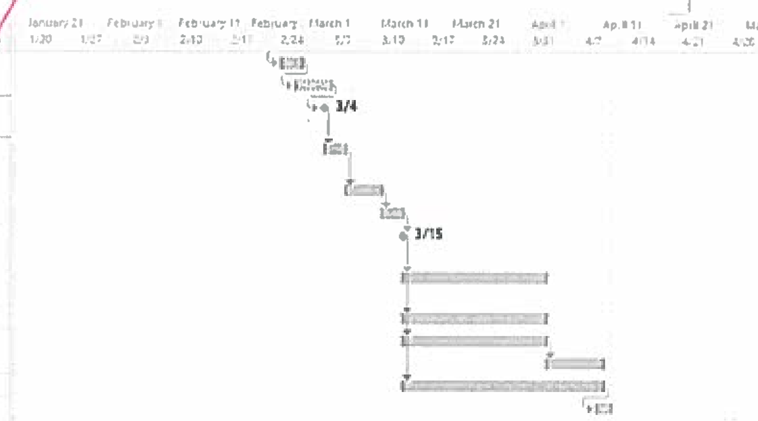
Name: Leily Mojarab

Sofia Martinez, Leily Mojarab, Kyle Cadiz, John Black
Microsoft Project

	Task Mode	Task Name	Duration	Start	Finish	Predecessors
1		Work on Scope of Work	6 days	Thu 10/25/18	Thu 11/1/18	
2		Scope of Work Assignment	0 days	Fri 11/2/18	Fri 11/2/18	1
3		Work on Microsoft Project	2 days	Wed 10/24/18	Thu 10/25/18	
4		Microsoft Project Assignment	0 days	Fri 11/2/18	Fri 11/2/18	3
5		Work on Progress Memo	2 days	Sat 10/27/18	Sun 10/28/18	
6		Progress Memorandum	0 days	Fri 11/2/18	Fri 11/2/18	5
7		Work on Progress Memo	2 days	Sat 11/10/18	Sun 11/11/18	
8		Progress Memorandum	0 days	Fri 11/16/18	Fri 11/16/18	
9		Licensure Site Review Assignment	0 days	Fri 11/16/18	Fri 11/16/18	
10		Group Review of Draft of Report	2 days	Sat 11/17/18	Mon 11/19/18	
11		Draft of Report	0 days	Mon 11/19/1	Mon 11/19/1	
12		Peer Review	0 days	Mon 11/26/1	Mon 11/26/1	
13		Oral Presentation	0 days	Fri 11/30/18	Fri 11/30/18	
14		Final Report and Poster Presentation	0 days	Fri 12/7/18	Fri 12/7/18	11
15		Determine Governmental Constraints	5 days	Mon 1/14/19	Fri 1/18/19	
16		Determine Loads Uniform Across All Alternative Materials	6 days	Mon 1/21/19	Mon 1/28/19	15
17		Alternate 1 Design Start: Concrete	0 days	Tue 1/29/19	Tue 1/29/19	16
18		Alternative 1 Dead loads	6 days	Tue 1/29/19	Tue 2/5/19	17
19		Cost Analysis	6 days	Wed 2/6/19	Wed 2/13/1	18
20		Raw Calculations	6 days	Thu 2/14/19	Thu 2/21/19	19
21		Alternative 2 Design Start: Steel	0 days	Fri 2/22/19	Fri 2/22/19	20
22		Alternative 2 Dead loads	3 days	Fri 2/22/19	Tue 2/26/19	21
23		Cost Analysis	3 days	Tue 2/26/19	Thu 2/28/19	22
24		Raw Calculations	3 days	Thu 2/28/19	Mon 3/4/19	23
25		Alternate 3 Design Start: Wood	0 days	Mon 3/4/19	Mon 3/4/1	24
26		Alternative 3 Dead Loads	3 days	Mon 3/4/19	Wed 3/6/19	25
27		Cost Analysis	3 days	Thu 3/7/19	Mon 3/11/1	26
28		Raw Calculations	3 days	Tue 3/12/19	Thu 3/14/19	27
29		Choose Final Alternative	0 days	Fri 3/15/19	Fri 3/15/19	28
30		Necessary Calculations	14 days	Fri 3/15/19	Wed 4/3/19	29
31		Virtual Model	14 days	Fri 3/15/19	Wed 4/3/19	29
32		Plan Sheets	14 days	Fri 3/15/19	Wed 4/3/19	29
33		Full Cost Analysis	6 days	Thu 4/4/19	Thu 4/11/19	32
34		Finish Report	20 days	Fri 3/15/19	Thu 4/11/19	29
35		Practice Oral Presentation	2 days	Thu 4/11/19	Fri 4/12/19	34







CE 484 – Progress Memorandum Grading Rubric – Spring 2019

Group # 4

9.9/10

Student Names:

1. John Black Author
2. Kyle Cadiz
3. Sofia Martinez
4. Leily Mojarab

Academic Advisor: Dr. Mehmet Inan
Project Title: **Sundon Berchtold Hall (Academic Building Design), Portland, OR**

Detailed, Thorough	Vague, Incomplete, Confusing	Wrong, Missing	Item
✓	____	____	Accomplishments since the previous memorandum: * a) What have you accomplished? b) What have you learned & what challenges have you faced? c) What persons have you contacted? d) What resources have you used? e) What have you concluded?
✓	____	____	Compare your progress with your Gantt Chart prepared in CE 483 in Fall 2018
✓	____	____	Tasks to be completed by individual members during the next period (To be specified for each member)
✓	____	____	Summary of time spent by individual members since previous Progress Memorandum (Table of billable items)
✓	____	____	Name of the primary author of the memorandum

*** To be written in text form (not bullets)**

January 23, 2019

U:admin/EGRsec/Mehmet/CE/484(was482)/ProgressMemorandum_Master

CE 484 PROGRESS MEMORANDUM FORMAT Spring 2019

Group# 4 Project Name: Dundon-Berchtold Hall (Academic Building Design)
Academic Advisor's Name: Dr. Mehmet Inan
Industrial Advisor's Name: Aaron Wegner, KPFF; Andrew Burke, Soderstrom, Kevin Kelly, Fortis
Due Date: February 15th, 2019

(3%) 1. ACCOMPLISHMENTS SINCE THE LAST MEMORANDUM & PROBLEMS ENCOUNTERED

a) What have you accomplished?

As a team we've finished the column and beam layout for the Classroom Building as well as finishing all dead loads except for the roof level. We've divided the work between team members to cover different levels and tasks so that by Spring Break we will be able to start RISA analysis all together. We've met with Mr. Aaron Wegner to discuss some of our raw calculations and clarify how we will size the steel we're using which we also got further information on from Dr. Kuhn.

as per Dr. Kuhn you'll need to rethink This...

b) What have you learned & what challenges have you faced?

We have learned about sizing beams and how to choose steel decking. We also learned about Steel layout and connection design. Additionally, we were able to go on another site visit and learn more about the construction process and see some of the important beams and column placements. Its been a challenge for us to immediately apply a lot of the concepts that we're learning from our advisors. While we will need to do this eventually, we are still gradually finishing the tasks we're working on now so that we can finish layouts and size our steel. Also, we're navigating how to make decisions when different tables or manuals have different values. From being a student and having an objectively correct answer to find, to now being in the Engineer's role and needing to make an educated decision and truly design has been a paradigm shift and a challenge but a welcome one.

c) What persons have you contacted?

We have contacted Mr. Aaron Wegner from KPFF, Mr. Kevin Kelly from Fortis Construction, and Dr. Kuhn for additional steel information.

d) What resources have you used?

We have used the ASCE 7, Steel Design Manual, Oregon Structural Specialty Code, and Verco Catalog. We have also referenced Dr. Kuhn for further information on Steel Decking and connections.

e) What have you concluded?

We have concluded that, again, we have been efficient in completing tasks split up. We've also concluded that we are on track to start the RISA analysis aspect of design before Spring Break. While we've learned a lot in two weeks, we have set tasks for each member to complete and what's left at this point before RISA is to finish each task and make sure our work is accurate so we can move on to the steel selection and sizing as a team.

January 16, 2019

(2%) 2. COMPARE YOUR PROGRESS WITH YOUR GANTT CHART PREPARED IN CE 483 FALL 2018

The team is currently finishing up dead loads, starting live loads, and finishing framing both the Signature Building and Classroom Building. We have diverted from the Microsoft Project calendar slightly as we aren't considering alternate materials for analysis, though we are on track for starting to do RISA analysis before Spring Break.

(2%) 3. TASKS TO BE COMPLETED BY INDIVIDUAL MEMBERS DURING THE NEXT PERIOD (TO BE SPECIFIED FOR EACH MEMBER)

Kyle will be finishing the exterior wall dead loads for both buildings and upon completion of the live loads will start selecting beams and columns with Sofia. Leily will start framing the columns and girders on the signature building. John will finish the roof and parapet dead loads then work on the live loads once the tributary areas are determined by Sofia. Sofia will find the tributary area of the classroom building and upon determination of the live loads start selecting beams and columns with Kyle.

(2%) 4. SUMMARY OF THE TIME SPENT BY INDIVIDUAL MEMBERS SINCE PREVIOUS MEMORANDUM (TABLE OF BILLABLE HOURS)

Name	Team Meetings (hrs)	Individual Tasks (hrs)	Task Descriptions	Total Hours
Kyle Cadiz	5.5	3	Classroom building steel framing plan	8.5
Leily Mojarab	5.5	2	Dead loads, floor finishes, research	7.5
John Black	5.5	2	Dead loads, roof and parapets	7.5
Sofia Martinez	5	2	Research on furniture loads, minutes and emails	7

Good

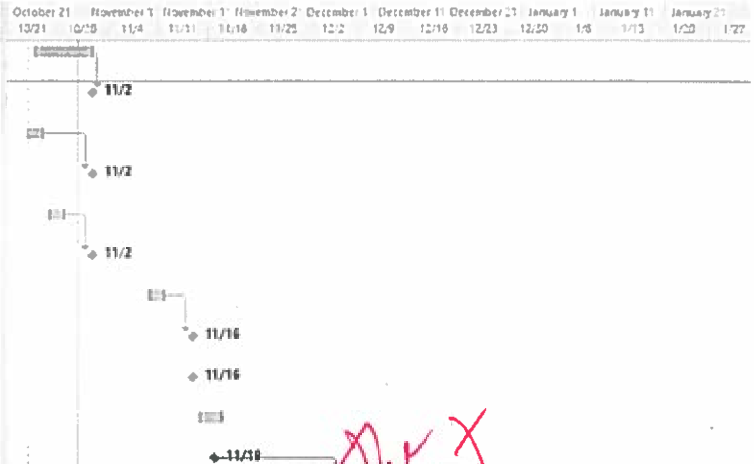
(1%) 5. NAME OF THE PRIMARY AUTHOR OF MEMORANDUM

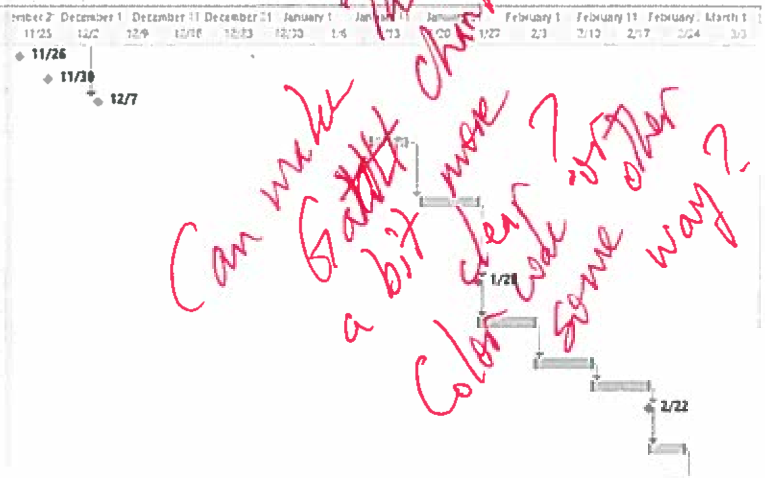
Name: John Black

January 16, 2019

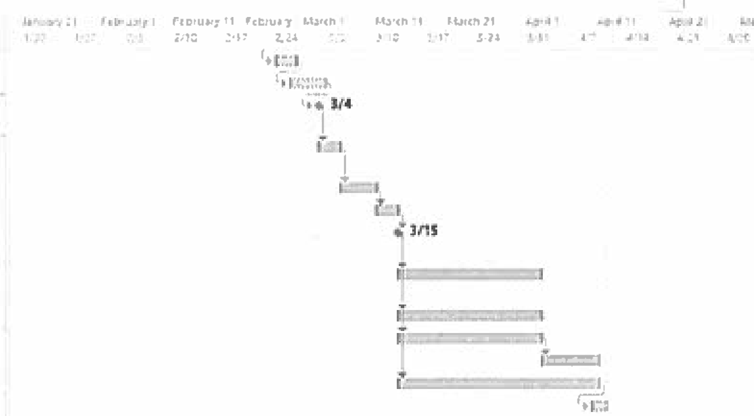
Sofia Martinez, Leily Mojarab, Kyle Cadiz, John Black
Microsoft Project

	Task Name	Duration	Start	Finish	Predecessors
1	Work on Scope of Work	6 days	Thu 10/25/18	Thu 11/1/18	
2	Scope of Work Assignment	0 days	Fri 11/2/18	Fri 11/2/18	1
3	Work on Microsoft Project	2 days	Wed 10/24/18	Thu 10/25/18	
4	Microsoft Project Assignment	0 days	Fri 11/2/18	Fri 11/2/18	3
5	Work on Progress Memo	2 days	Sat 10/27/18	Sun 10/28/18	
6	Progress Memorandum	0 days	Fri 11/2/18	Fri 11/2/18	5
7	Work on Progress Memo	2 days	Sat 11/10/18	Sun 11/11/18	
8	Progress Memorandum	0 days	Fri 11/16/18	Fri 11/16/18	7
9	Licensure Site Review Assignment	0 days	Fri 11/16/18	Fri 11/16/18	
10	Group Review of Draft of Report	2 days	Sat 11/17/18	Mon 11/19/18	
11	Draft of Report	0 days	Mon 11/19/1	Mon 11/19/1	
12	Peer Review	0 days	Mon 11/26/1	Mon 11/26/1	
13	Oral Presentation	0 days	Fri 11/30/18	Fri 11/30/18	
14	Final Report and Poster Presentation	0 days	Fri 12/7/18	Fri 12/7/18	11
15	Determine Governmental Constraints	5 days	Mon 1/14/19	Fri 1/18/19	
16	Determine Loads Uniform Across All Alternative Materials	6 days	Mon 1/21/19	Mon 1/28/19	15
17	Alternate 1 Design Start: Concrete	0 days	Tue 1/29/19	Tue 1/29/19	16
18	Alternative 1 Dead loads	6 days	Tue 1/29/19	Tue 2/5/19	17
19	Cost Analysis	6 days	Wed 2/6/19	Wed 2/13/1	18
20	Raw Calculations	6 days	Thu 2/14/19	Thu 2/21/19	19
21	Alternative 2 Design Start: Steel	0 days	Fri 2/22/19	Fri 2/22/19	20
22	Alternative 2 Dead loads	3 days	Fri 2/22/19	Tue 2/26/19	21
23	Cost Analysis	3 days	Tue 2/26/19	Thu 2/28/19	22
24	Raw Calculations	3 days	Thu 2/28/19	Mon 3/4/19	23
25	Alternate 3 Design Start: Wood	0 days	Mon 3/4/19	Mon 3/4/1	24
26	Alternative 3 Dead Loads	3 days	Mon 3/4/19	Wed 3/6/19	25
27	Cost Analysis	3 days	Thu 3/7/19	Mon 3/11/1	26
28	Raw Calculations	3 days	Tue 3/12/19	Thu 3/14/19	27
29	Choose Final Alternative	0 days	Fri 3/15/19	Fri 3/15/19	28
30	Necessary Calculations	14 days	Fri 3/15/19	Wed 4/3/19	29
31	Virtual Model	14 days	Fri 3/15/19	Wed 4/3/19	29
32	Plan Sheets	14 days	Fri 3/15/19	Wed 4/3/19	29
33	Full Cost Analysis	6 days	Thu 4/4/19	Thu 4/11/19	32
34	Finish Report	20 days	Fri 3/15/19	Thu 4/11/19	29
35	Practice Oral Presentation	2 days	Thu 4/11/19	Fri 4/12/19	34





Can make the Gantt chart a bit more clear? Color code or some other way?



CE 484 – Progress Memorandum Grading Rubric – Spring 2019

Group # 4

8.9/10

Student Names:
1. John Black
2. Kyle Cadiz Author
3. Sofia Martinez
4. Leily Mojarab

Academic Advisor: Dr. Mehmet Inan
Project Title: **Sundon Berchtold Hall (Academic Building Design), Portland, OR**

Detailed, Thorough	Vague, Incomplete, Confusing	Wrong, Missing	Item
	✓		Accomplishments since the previous memorandum: * a) What have you accomplished? b) What have you learned & what challenges have you faced? c) What persons have you contacted? d) What resources have you used? e) What have you concluded?
✓			Compare your progress with your Gantt Chart prepared in CE 483 in Fall 2018
✓			Tasks to be completed by individual members during the next period (To be specified for each member)
✓			Summary of time spent by individual members since previous Progress Memorandum (Table of billable items)
✓			Name of the primary author of the memorandum

*** To be written in text form (not bullets)**

January 23, 2019

U:admin/EGRsec/Mehmet/CE/484(was482)/ProgressMemorandum_Master

8.9/10

CE 484 PROGRESS MEMORANDUM FORMAT Spring 2019

Group# 4 **Project Name:** Dundon-Berchtold Hall (Academic Building Design)
Academic Advisor's Name: Dr. Mehmet Inan
Industrial Advisor's Name: Aaron Wegner, KPFF; Andrew Burke, Soderstrom, Kevin Kelly, Fortis
Due Date: March 15th, 2019

(3%) 1. ACCOMPLISHMENTS SINCE THE LAST MEMORANDUM & PROBLEMS ENCOUNTERED

a) What have you accomplished?

Not much progress since 2/22/19 last memo

As a team, we've finished the column and beam layout for the Signature Building and the dead load calculations for the roof. After the column and beam layout was finished for the Classroom Building, the tributary areas were established. We've gathered information about steel decking and selected a deck to use throughout our design. We've also collected information about LEED certification and envision guidelines that will affect our design.

As per emails I am more clear

b) What have you learned & what challenges have you faced?

We've received clarification on how to select steel decking using the Verco catalog. We are also continuing to gather information pertaining to earthquake design that we will be able to utilize in future calculations for lateral loads. We also learned, through Dr. Kuhn, that we do not need to conduct a digital analysis via RISA for our gravity loads. Some of the challenges we have faced involve the dedication of our time to the project during midterms and break. The group's schedule during this time made it difficult to collaborate and finish work in a timely manner.

c) What persons have you contacted?

We ~~have~~ contacted Mr. Aaron Wegner from KPFF, and Dr. Kuhn for additional steel information.

d) What resources have you used?

We have used the ASCE 7, Steel Design Manual, Oregon Structural Specialty Code, and Verco Catalog. We have also referenced Dr. Kuhn for further information on Steel Decking and connections.

e) What have you concluded?

We have concluded that there are some tasks that we originally anticipated that are more important than others. Our goal from here on out is to finish a design that satisfies all gravity loads and generate a 3D model and framing plan. Regarding lateral loads, we will provide calculations for base shear and story shear. We will refrain from actually designing the lateral brace system.

March 14, 2019

(2%) 2. COMPARE YOUR PROGRESS WITH YOUR GANTT CHART PREPARED IN CE 483 FALL 2018

The team is currently calculating live loads based on the tributary areas we establish. The next task is to design the steel beams, girders, and columns. We have diverted from the Gannt chart slightly as we aren't considering alternate materials for analysis or a RISA analysis, however we are on track to design all members by April.

(2%) 3. TASKS TO BE COMPLETED BY INDIVIDUAL MEMBERS DURING THE NEXT PERIOD (TO BE SPECIFIED FOR EACH MEMBER)

Kyle will be calculating and reducing the live loads of the Classroom Building with help from Leily. John will establish tributary areas for the Signature Building, which will be passed on to Kyle and Leily for live load calculations. Kyle, Leily, John, and Sofia will then work together to design the steel beams, girders, and columns using the Steel Manual. Sofia will use the dead load calculations and the soon to be determined live load calculations to calculate base shear and story shear.

(2%) 4. SUMMARY OF THE TIME SPENT BY INDIVIDUAL MEMBERS SINCE PREVIOUS MEMORANDUM (TABLE OF BILLABLE HOURS)

Name	Team Meetings (hrs)	Individual Tasks (hrs)	Task Descriptions	Total Hours
Kyle Cadiz	6	2	Familiarization with the Steel Manual and live load calculations	7
Leily Mojarab	6	4	Communication with all advisors, Signature Building steel layout	9
John Black	6	2	Dead loads calculations and Signature Building tributary areas	7
Sofia Martinez	6	4	Documentation of all meetings, establishing tributary areas of the Classroom Building	9

(1%) 5. NAME OF THE PRIMARY AUTHOR OF MEMORANDUM

Name: Kyle Cadiz

March 14, 2019

Sofia Martinez, Leily Mojarab, Kyle Cadiz, John Black
Microsoft Project

	Task Mode	Task Name	Duration	Start	Finish	Predecessors
1		Work on Scope of Work	6 days	Thu 10/25/18	Thu 11/1/18	
2		Scope of Work Assignment	0 days	Fri 11/2/18	Fri 11/2/18	1
3		Work on Microsoft Project	2 days	Wed 10/24/18	Thu 10/25/18	
4		Microsoft Project Assignment	0 days	Fri 11/2/18	Fri 11/2/18	3
5		Work on Progress Memo	2 days	Sat 10/27/18	Sun 10/28/18	
6		Progress Memorandum	0 days	Fri 11/2/18	Fri 11/2/18	5
7		Work on Progress Memo	2 days	Sat 11/10/18	Sun 11/11/18	
8		Progress Memorandum	0 days	Fri 11/16/18	Fri 11/16/18	7
9		Licensure Site Review Assignment	0 days	Fri 11/16/18	Fri 11/16/18	
10		Group Review of Draft of Report	2 days	Sat 11/17/18	Mon 11/19/18	
11		Draft of Report	0 days	Mon 11/19/1	Mon 11/19/1	
12		Peer Review	0 days	Mon 11/26/1	Mon 11/26/1	
13		Oral Presentation	0 days	Fri 11/30/18	Fri 11/30/18	
14		Final Report and Poster Presentation	0 days	Fri 12/7/18	Fri 12/7/18	11
15		Determine Governmental Constraints	5 days	Mon 1/14/19	Fri 1/18/19	
16		Determine Loads Uniform Across All Alternative Materials	6 days	Mon 1/21/19	Mon 1/28/19	15
17		Alternate 1 Design Start: Concrete	0 days	Tue 1/29/19	Tue 1/29/19	16
18		Alternative 1 Dead loads	6 days	Tue 1/29/19	Tue 2/5/19	17
19		Cost Analysis	6 days	Wed 2/6/19	Wed 2/13/1	18
20		Raw Calculations	6 days	Thu 2/14/19	Thu 2/21/19	19
21		Alternative 2 Design Start: Steel	0 days	Fri 2/22/19	Fri 2/22/19	20
22		Alternative 2 Dead loads	3 days	Fri 2/22/19	Tue 2/26/19	21
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24		Raw Calculations	3 days	Thu 2/28/19	Mon 3/4/19	23
25		Alternate 3 Design Start: Wood	0 days	Mon 3/4/19	Mon 3/4/1	24
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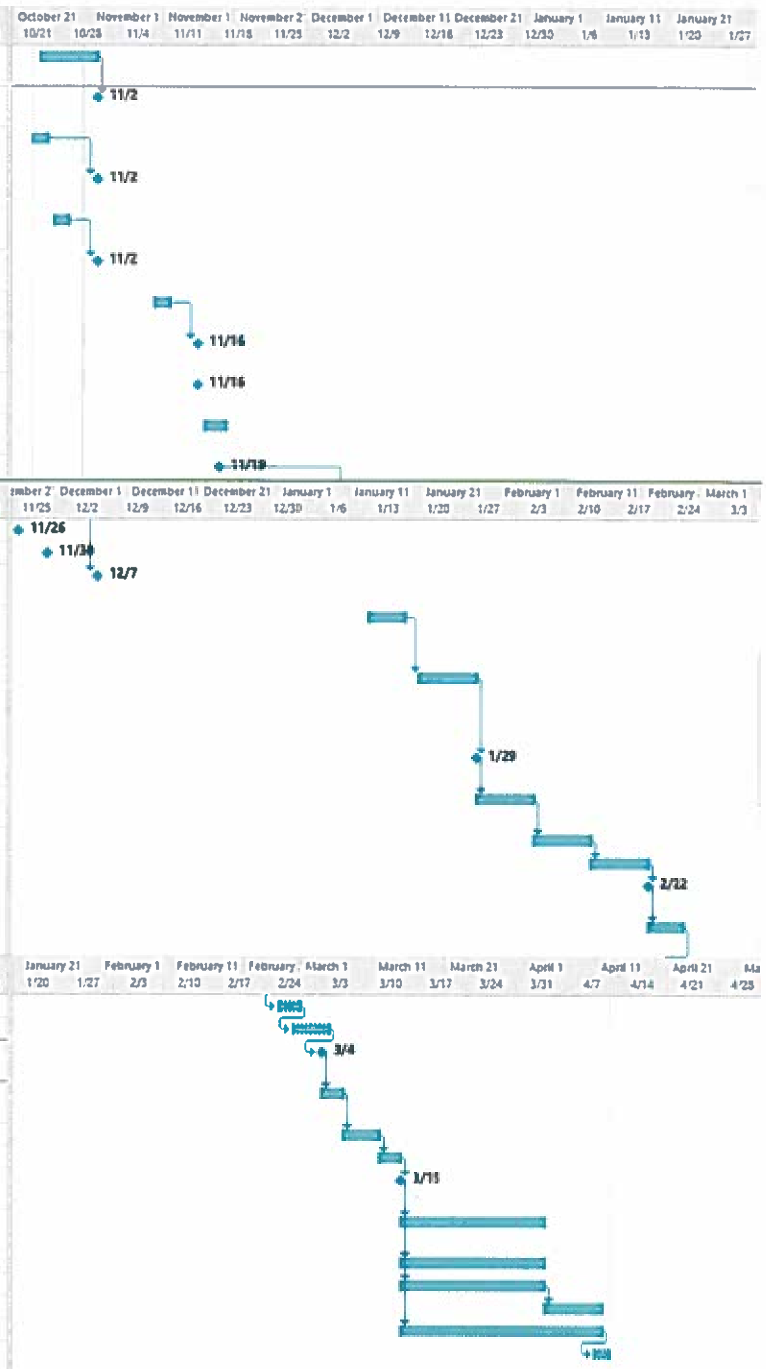

CE 484 – Progress Memorandum Grading Rubric – Spring 2019

Group # 4

10/10

Student Names:
1. John Black
2. Kyle Cadiz
3. Sofia Martinez Author
4. Leily Mojarab

Academic Advisor: Dr. Mehmet Inan
Project Title: **Sundon Berchtold Hall (Academic Building Design), Portland, OR**

Detailed, Thorough	Vague, Incomplete, Confusing	Wrong, Missing	Item
✓	___	___	Accomplishments since the previous memorandum: * a) What have you accomplished? b) What have you learned & what challenges have you faced? c) What persons have you contacted? d) What resources have you used? e) What have you concluded?
✓	___	___	Compare your progress with your Gantt Chart prepared in CE 483 in Fall 2018
✓	___	___	Tasks to be completed by individual members during the next period (To be specified for each member)
✓	___	___	Summary of time spent by individual members since previous Progress Memorandum (Table of billable items)
✓	___	___	Name of the primary author of the memorandum

*** To be written in text form (not bullets)**

January 23, 2019

U:admin/EGRsec/Mehmet/CE/484(was482)/ProgressMemorandum_Master

CE 484 PROGRESS MEMORANDUM FORMAT Spring 2019

Group# 4 **Project Name:** Dundon-Berchtold Hall (Academic Building Design)
Academic Advisor's Name: Dr. Mehmet Inan
Industrial Advisor's Name: Aaron Wegner, KPFF; Andrew Burke, Soderstrom; Kevin Kelly, Fortis
Due Date: ~~March 5, 2019~~ April 5, 2019

(3%) **1. ACCOMPLISHMENTS SINCE THE LAST MEMORANDUM & PROBLEMS ENCOUNTERED**

a) What have you accomplished?
We have finished designing a majority of the framing members. This includes beams, girders, and columns. Following our column design, we have also begun the design of the foundation system. This includes the basement wall and footings. We have also begun to edit and add to our presentation for Founder's Day. Additionally, we have made progress on our 3D model of the framing plan in REVIT.

b) What have you learned & what challenges have you faced?
We have learned how to design framing members such as girders, columns, and connections. We have also gotten information from Dr. Kuhn on how to size footings and the basement walls. We have had a plethora of personal issues come up with most of our team members which have impacted our individual and group productivity.

c) What persons have you contacted?
We have contacted our industry advisor, Mr. Aaron Wegner from KPFF twice. We have also met with Dr. Kuhn to discuss steel design.

d) What resources have you used?
We have used the ASCE 7, IBC, Steel Manual, Verco Steel Floor Deck Catalog VF5, and Oregon Structural Specialty Code.

e) What have you concluded?
We have concluded that designing every single member of the framing system would be a highly iterative process. Dr. Kuhn has suggested, with Dr. Inan's approval, that for the sake of time and academic benefit, we should focus on the specific aspects of the design. For instance, we will design a few columns and girders so as to spend more time learning new aspects of design.

(2%) 2. COMPARE YOUR PROGRESS WITH YOUR GANTT CHART PREPARED IN CE 483 FALL 2018

We are currently finishing up the design of our selected aspects of the building. We are also continuing the modeling of the finished members in REVIT. We have diverted from the Gantt chart slightly as we aren't considering alternate materials for analysis, however we are on track to design all types of members by next week.

(2%) 3. TASKS TO BE COMPLETED BY INDIVIDUAL MEMBERS DURING THE NEXT PERIOD (TO BE SPECIFIED FOR EACH MEMBER)

Kyle will finish designing columns for the classroom building and footing design. Leily will finish the slides for our Founder's Day presentation and then will work on the report. John will design girders and columns for the signature building. Sofia will finish the 3D modeling of the framing system in REVIT.

(2%) 4. SUMMARY OF THE TIME SPENT BY INDIVIDUAL MEMBERS SINCE PREVIOUS MEMORANDUM (TABLE OF BILLABLE HOURS)

Name	Team Meeting (hrs)	Individual Tasks (hrs)	Task Descriptions	Total Hours
John Black	8	9	Tributary areas and beam design	17
Kyle Cadiz	8	11	Beam, girder and column design	19
Leily Mojarab	8	4	Basement Wall design, beam and girder design	12
Sofia Martinez	8	6	Tributary Areas	14

(1%) 5. NAME OF THE PRIMARY AUTHOR OF MEMORANDUM

Name: Sofia Martinez

Sofia Martinez, Leily Mojarab, Kyle Cadiz, John Black

Microsoft Project

	Task Mode	Task Name	Duration	Start	Finish	Predecessors
1		Work on Scope of Work	6 days	Thu 10/25/18	Thu 11/1/18	
2		Scope of Work Assignment	0 days	Fri 11/2/18	Fri 11/2/18	1
3		Work on Microsoft Project	2 days	Wed 10/24/18	Thu 10/25/18	
4		Microsoft Project Assignment	0 days	Fri 11/2/18	Fri 11/2/18	3
5		Work on Progress Memo	2 days	Sat 10/27/18	Sun 10/28/18	
6		Progress Memorandum	0 days	Fri 11/2/18	Fri 11/2/18	5
7		Work on Progress Memo	2 days	Sat 11/10/18	Sun 11/11/18	
8		Progress Memorandum	0 days	Fri 11/16/18	Fri 11/16/18	7
9		Licensure Site Review Assignment	0 days	Fri 11/16/18	Fri 11/16/18	
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16		Determine Loads Uniform Across All Alternative Materials	6 days	Mon 1/21/19	Mon 1/28/19	15
17		Alternate 1 Design Start: Concrete	0 days	Tue 1/29/19	Tue 1/29/19	16
18		Alternative 1 Dead loads	6 days	Tue 1/29/19	Tue 2/5/19	17
19		Cost Analysis	6 days	Wed 2/6/19	Wed 2/13/1!	18
20		Raw Calculations	6 days	Thu 2/14/19	Thu 2/21/19	19
21		Alternative 2 Design Start: Steel	0 days	Fri 2/22/19	Fri 2/22/19	20
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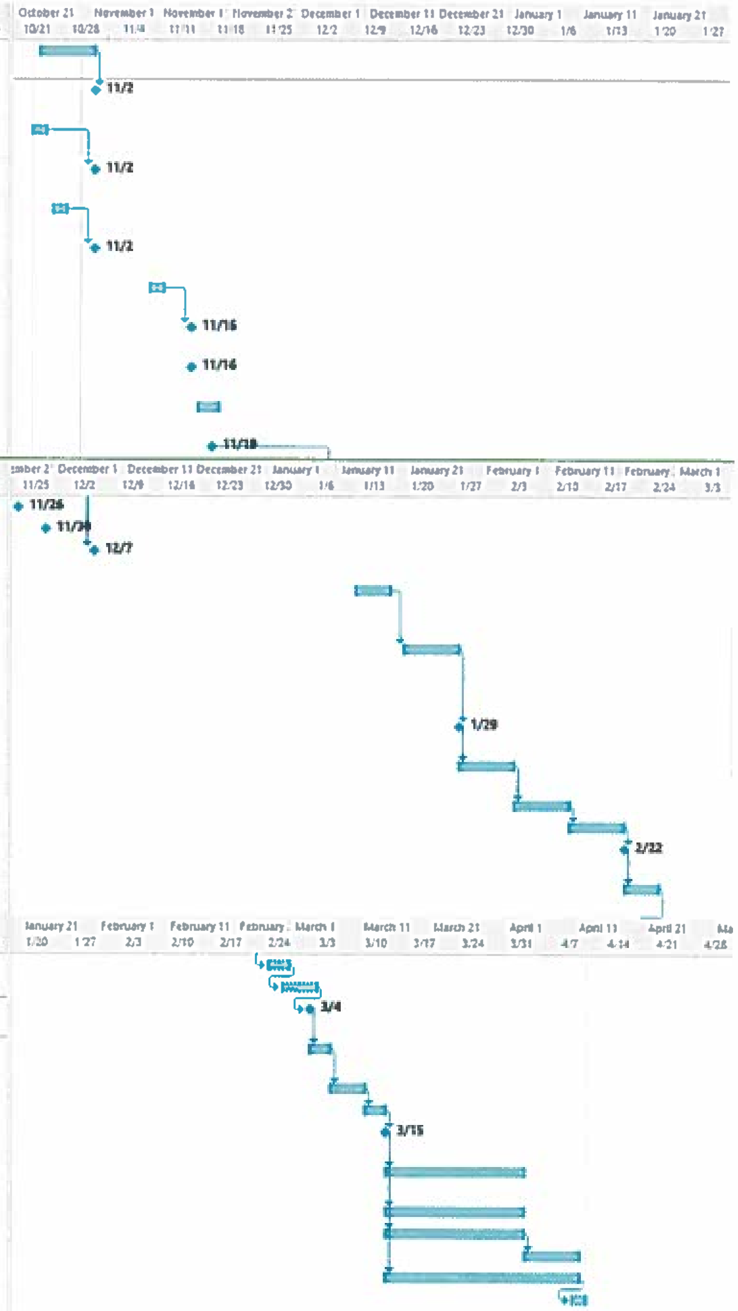


APPENDIX F

PROJECT TEAM CHARTER

SENIOR CAPSTONE DESIGN

TEAM CHARTER 2018

PROJECT NAME:	UP ACADEMIC BUILDING

TEAM MEMBER NAME:	CONTACT INFO (EMAIL/PHONE)	PREFERRED CONTACT METHOD:
LEILY MOJARAB	MOJARAB19/(253)-754-2169	CELL PHONE
JOHN BLACK	BLACK19/(808)-699-5248	CELL PHONE
KYLE CADIZ	CADIZ19/(808)-264-8376	CELL PHONE
SOFIA MARTINEZ	MARTINES19/(530)-282-6292	CELL PHONE

TEAM MEMBER NAME:	STRENTHS RELATED TO TEAMWORK	WEAKNESSES RELATED TO TEAMWORK
LEILY MOJARAB	COMMUNICATION/ORGANIZATION	PROCRASTINATION
JOHN BLACK	FLEXIBILITY/COMMUNICATION	SOCIALIZING/PROCRASTINATING
KYLE CADIZ	TIME MANAGEMENT/COMMUNICATION	PROCRASTINATION
SOFIA MARTINEZ	SCHEDULING/PROBLEM SOLVING	PROCRASTINATION

ls

What are your team's goals for this project? These should relate to the team's performance on the project as well as the processes that the team will follow to complete the project. What are your team's expectations regarding the quality and timeliness of the team's work?

Finish, work well together, have something that we are proud of at the end, become fluent in a new program, learn more in our weak fields.

Roles

Who is responsible for each activity? What roles will each member have? Don't forget to include logistical tasks, such as arranging meetings, preparing agendas and meeting minutes, and team process roles, such as questioning (devil's advocate), ensuring that everyone's opinion is heard, etc.

Leily- Communication

John- Social

Kyle- IT

Sofia- Scribe

All- Honesty, communication between the four of us

Schedule

What are the known deliverables that your team needs to plan for? (Include known due dates & events)

(On syllabus), no budget required, no prototype expected to be built

How often will you meet with your team? Where will you meet? When?

Once a week, after or during capstone, supplemental meetings TBD.

How often will you meet with your industry advisor? Where will you meet? When?

TBD in the Fall

Attendance

What are your team's expectations regarding meeting attendance (being on time, leaving early, missing meetings, etc.)?

Being late- don't care

Industry advisors we HAVE to go.

Up for review if it goes bad

What constitutes an acceptable excuse for missing a meeting or a deadline? What types of excuses will not be considered acceptable?

-Sick

-Emergency

-Out of town

-Open Communication at all times

What process will team members follow if they have an emergency and cannot attend a team meeting or complete their individual work promised to the team (deliverable)?

-Communicate about missing meetings

-Decide a week in advance if you cannot finish, if not we will brainstorm a solution

Accountability & Teamwork

What are your team's expectations regarding the quality of team members' preparation for team meetings and the quality of the deliverables that members bring to the team?

Meetings- don't come in blind, prepare together for industry advisors

Deliverables- have our own deadline two days ahead to check each other's work

What are your team's expectations regarding team members' ideas, interactions with the team, cooperation, attitudes, and anything else regarding team member contributions? What will your group process rules be (everyone has a voice, active listening, etc.)?

Everyone had a voice, active listening, throw out ideas and choose one as a team, total honesty

What methods will be used to keep the team on track? *How will your team ensure that members contribute and that the team performs as expected? How will your team reward members who do well and manage members whose performance is below expectations?*

Group calendar, checking each other's work a day or two before we turn it in.

How will you make decisions in your group? *Consensus? Vote? How will you handle disagreements?*

Democracy

Other Rules

What other rules would you like to set for your team?

Communicate and stay Honesty

Commitment

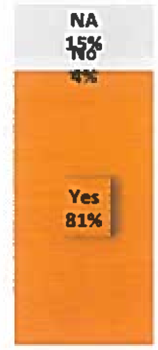
TEAM MEMBER NAME: LEILY MOJARAB	SIGNATURE:
TEAM MEMBER NAME: JOHN BLACK	SIGNATURE:
TEAM MEMBER NAME: KYLE CADIZ	SIGNATURE:
TEAM MEMBER NAME: SOFIA MARTINEZ	SIGNATURE:
TEAM MEMBER NAME:	SIGNATURE:

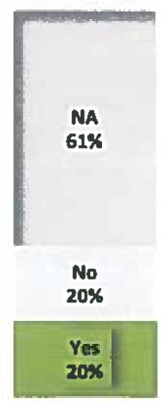
APPENDIX G

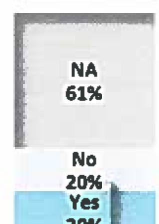
MISCELLANEOUS

Envision Rating System
Self-Assessment Checklist
For Public Comment Only - Not for Project Use

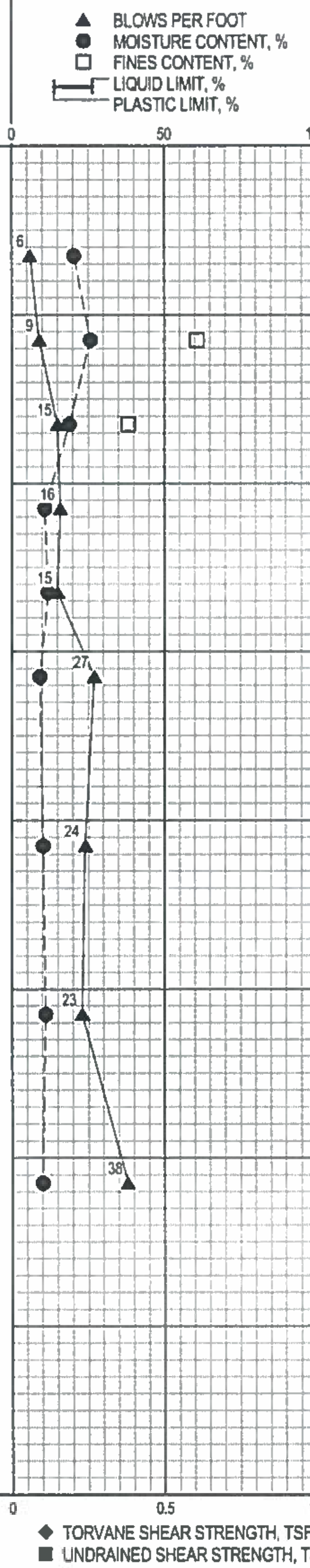
	Category	Subcategory	Credit	Y	N	NA	Score
	QUALITY OF LIFE	PURPOSE	QL1.1 Improve community quality of life	3	0	0	3 of 3
			QL1.2 Stimulate sustainable growth and development	3	0	0	3 of 3
3			QL1.3 Develop local skills and capabilities	2	1	0	2 of 3
4		COMMUNITY	QL2.1 Enhance public health and safety	0	0	1	0 of 0
5			QL2.2 Minimize noise and vibration	1	0	0	1 of 1
6			QL2.3 Minimize light pollution	1	0	0	1 of 1
7			QL2.4 Improve community mobility and access	3	0	0	3 of 3
8			QL2.5 Encourage alternative modes of transportation	1	0	1	1 of 1
9			QL2.6 Improve site accessibility, safety and wayfinding	2	0	1	2 of 2
10		WELLBEING	QL3.1 Preserve historic and cultural resources	1	0	1	1 of 1
11			QL3.2 Preserve views and local character	2	0	0	2 of 2
12			QL3.3 Enhance public space	2	0	0	2 of 2
			TOTAL	21	1	4	21 of 22
13	LEADERSHIP	COLLABORATION	LD1.1 Provide effective leadership and commitment	0	1	2	0 of 1
14			LD1.2 Establish a sustainability management system	1	0	0	1 of 1
15			LD1.3 Foster collaboration and teamwork	3	0	0	3 of 3
16			LD1.4 Provide for stakeholder involvement	3	0	0	3 of 3
17		MANAGEMENT	LD2.1 Pursue by-product synergy opportunities	1	0	0	1 of 1
18			LD2.2 Improve infrastructure integration	3	0	0	3 of 3
19		PLANNING	LD3.1 Plan for long-term monitoring and maintenance	2	0	0	2 of 2
20			LD3.2 Address conflicting regulations and policies	2	0	0	2 of 2
21			LD3.3 Extend useful life	1	0	0	1 of 1
			TOTAL	16	1	2	16 of 17
22	RESOURCE ALLOCATION	MATERIALS	RA1.1 Reduce Net Embodied Energy	0	2	0	0 of 2
23			RA1.2 Support Sustainable Procurement Practices	0	3	0	0 of 3
24			RA1.3 Use Recycled Materials	1	1	0	1 of 2
25			RA1.4 Use Regional Materials	0	2	0	0 of 2
26			RA1.5 Divert Waste from Landfills	1	2	0	1 of 3
			RA1.6 Reduce Excavated Materials Taken off Site	3	0	0	3 of 3
			RA1.7 Provide for Deconstruction and Recycling	1	2	0	1 of 3
29		ENERGY	RA2.1 Reduce energy consumption	0	3	0	0 of 3
30			RA2.2 Use renewable energy	0	2	0	0 of 2
31			RA2.3 Commission and monitor energy systems	3	0	0	3 of 3
32		WATER	RA3.1 Protect fresh water availability	4	1	2	4 of 5
33			RA3.2 Reduce potable water consumption	0	3	1	0 of 3
34			RA3.3 Monitor water systems	0	0	4	0 of 0
			TOTAL	13	21	7	13 of 34
35	NATURAL WORLD	SITING	NW1.1 Preserve prime habitat	0	0	5	0 of 0
36			NW1.2 Protect wetlands and surface water	0	0	3	0 of 0
37			NW1.3 Preserve prime farmland	0	0	1	0 of 0
38			NW1.4 Avoid adverse geology	3	0	0	3 of 3
39			NW1.5 Preserve floodplain functions	0	0	6	0 of 0
40			NW1.6 Avoid unsuitable development on steep slopes	0	0	2	0 of 0
41			NW1.7 Preserve greenfields	2	0	0	2 of 2
42		LAND & WATER	NW2.1 Manage stormwater	1	1	0	1 of 2
43			NW2.2 Reduce pesticide and fertilizer impacts	2	2	1	2 of 4
44			NW2.3 Prevent surface and groundwater contamination	0	2	1	0 of 2
45		BIODIVERSITY	NW3.1 Preserve species biodiversity	0	0	4	0 of 0
46			NW3.2 Control invasive species	1	2	0	1 of 3
47			NW3.3 Restore disturbed soils	0	2	0	0 of 2
48			NW3.4 Maintain wetland and surface water functions	0	0	5	0 of 0
			TOTAL	9	9	28	9 of 18
49	CLIMATE	EMISSION	CR1.1 Reduce greenhouse gas emissions	0	1	1	0 of 1
50			CR1.2 Reduce air pollutant emissions	2	0	0	2 of 2
51		RESILIENCE	CR2.1 Assess climate threat	0	1	0	0 of 1
52			CR2.2 Avoid traps and vulnerabilities	0	2	0	0 of 2
			CR2.3 Prepare for long-term adaptability	1	0	0	1 of 1
			CR2.4 Prepare for short-term hazards	2	0	0	2 of 2
55			CR2.5 Manage heat islands effects	0	1	0	0 of 1
			TOTAL	5	5	1	5 of 10







DEPTH, FT	CLASSIFICATION OF MATERIAL (Surface Elevation: 169.0 ft [±] (City of Portland))	ELEVATION, FT / DEPTH, FT	INSTALLATION	SAMPLE NO.	BLOW COUNT	COMMENTS AND ADDITIONAL TESTS
0–7.5	Sandy SILT, brown mottled rust, medium stiff to stiff, fine-grained sand, 1-in.-thick layer of wood mulch at surface			S-1	2 / 3 / 3	Prior to drilling B-1, infiltration testing was conducted in a borehole 12 ft east of B-1
5				S-2	3 / 3 / 6	Drill rig shudders near 6.5 ft; possible gravelly layer
7.5	SAND, some silt to silty, brown-gray, medium dense, fine to medium grained	161.5 / 7.5		S-3	6 / 7 / 8	
10	—scattered subrounded gravel below 10 ft			S-4	8 / 8 / 8	
				S-5	7 / 7 / 8	
15	—trace to some silt below 15 ft			S-6	12 / 11 / 16	Difficult drilling and significant slough in each sample below 10 ft; periodically add water to improve cutting return
20				S-7	12 / 12 / 12	
25	—fine to coarse grained below 25 ft			S-8	17 / 11 / 12	
27	—dense below 27 ft					Drilling refusal at 27 ft; switch to grouser bit
30				S-9	19 / 16 / 22	
31.5	(5/26/2016)	137.5 / 31.5				
	Groundwater not encountered					
35						
40						



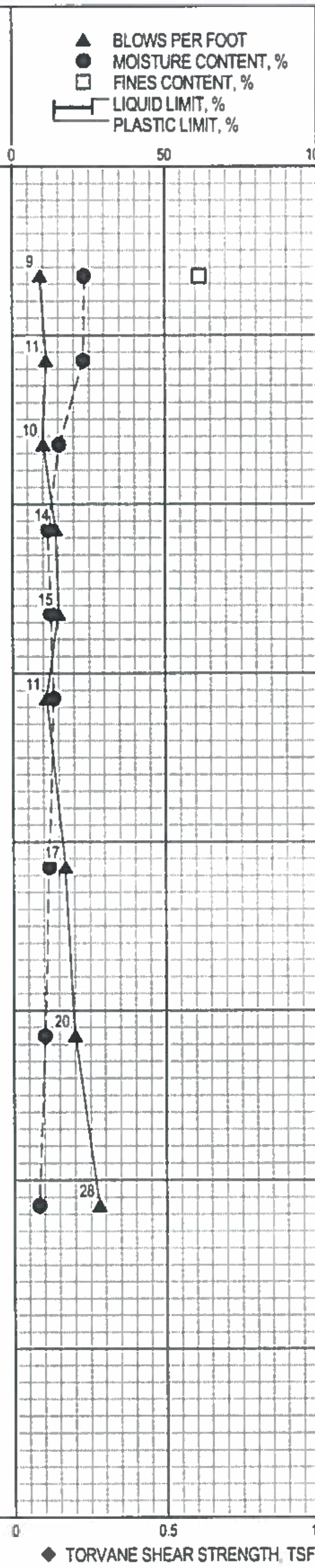
Logged By: M. Banks	Drilled by: Greg Vandehey Soil Sampling
Date Started: 5/26/16	Coordinates: Not Available
Drilling Method: Solid-Stem Auger Equipment: Simco 2400SK Trailer-Mounted Drill Rig Hole Diameter: 4 in.	Hammer Type: Manual Weight: 140 lb Drop: 30 in. Energy Ratio: Not Available
Note: See Legend for Explanation of Symbols	

GRI

BORING B-1

JUNE 2016 JOB NO. 5856 FIG. 1A

DEPTH, FT	CLASSIFICATION OF MATERIAL	ELEVATION, FT / DEPTH, FT	SAMPLE NO.	BLOW COUNT	COMMENTS AND ADDITIONAL TESTS
	Surface Elevation: 172.0 ft [±] (City of Portland)				
0	Sandy SILT, brown mottled rust, stiff, fine-grained sand, 3-in.-thick heavily-rooted zone at surface				
			S-1	3 4 5	
5			S-2	3 4 7	
7.5	SAND, trace to some silt, brown-gray, medium dense, fine to medium grained	164.5 / 7.5	S-3	6 5 5	
10			S-4	8 7 7	
			S-5	9 8 7	Difficult drilling and significant slough in each sample below 10 ft; periodically add water to improve cutting return
15			S-6	5 5 6	
20	---fine- to coarse-grained sand, scattered subrounded gravel below 20 ft		S-7	6 7 10	
25			S-8	10 9 11	
30			S-9	12 13 15	
31.5	(5/26/2016) Groundwater not encountered	140.5 / 31.5			
35					
40					



GRI BORING LOG (LAT/LONG) GRI DATA TEMPLATE.GDT 6/23/16

Logged By: M. Banks	Drilled by: Greg Vandehey Soil Sampling
Date Started: 5/26/16	Coordinates: Not Available
Drilling Method: Solid-Stem Auger Equipment: Simco 2400SK Trailer-Mounted Drill Rig Hole Diameter: 4 in.	Hammer Type: Manual Weight: 140 lb Drop: 30 in. Energy Ratio: Not Available
Note: See Legend for Explanation of Symbols	

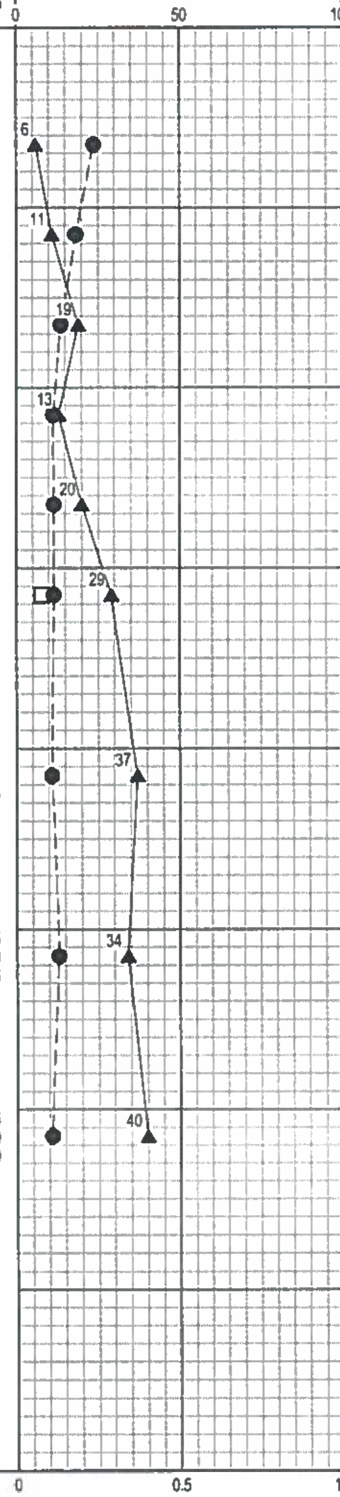
GRI

BORING B-2

JUNE 2016 JOB NO. 5856 FIG. 2A

DEPTH, FT	GRAPHIC LOG	CLASSIFICATION OF MATERIAL	ELEVATION, FT / DEPTH, FT	INSTALLATION	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT	COMMENTS AND ADDITIONAL TESTS
		Surface Elevation: 170.0 ft [±] (City of Portland)						
0		Silty SAND, brown, loose to medium dense, fine grained, 1-in.-thick layer of wood mulch at surface						
					S-1	I	3 2 4	
5					S-2	I	4 5 6	
		—some silt, brown-gray, medium dense, fine to medium grained below 7.5 ft			S-3	I	7 8 11	
10					S-4	I	7 7 6	
					S-5	I	12 9 11	Difficult drilling and significant slough in each sample below 10 ft; periodically add water to improve cutting return
15					S-6	I	15 18 11	
20		—trace to some silt, dense below 20 ft			S-7	I	16 17 20	
25					S-8	I	25 19 15	
30					S-9	I	16 20 20	
		(5/27/2016) Groundwater not encountered	138.5 / 31.5					
35								
40								

▲ BLOWS PER FOOT
● MOISTURE CONTENT, %
□ FINES CONTENT, %
LIQUID LIMIT, %
PLASTIC LIMIT, %



◆ TORVANE SHEAR STRENGTH, TSF
■ UNDRAINED SHEAR STRENGTH, TSF

Logged By: C. Jones	Drilled by: Greg Vandehey Soil Sampling
Date Started: 5/27/16	Coordinates: Not Available
Drilling Method: Solid-Stem Auger Equipment: Simco 2400SK Trailer-Mounted Drill Rig Hole Diameter: 4 in.	Hammer Type: Manual Weight: 140 lb Drop: 30 in.
Note: See Legend for Explanation of Symbols	Energy Ratio: Not Available

GRI

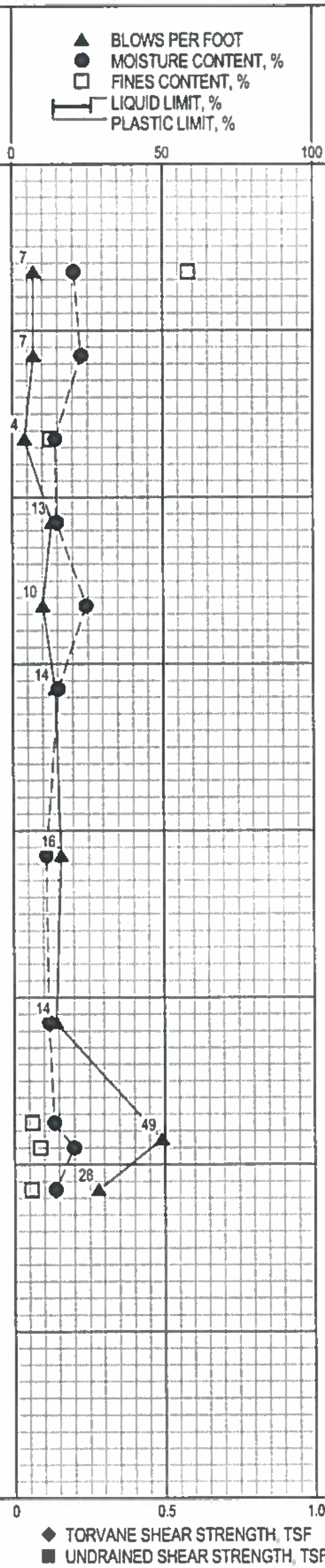
BORING B-3

JUNE 2016 JOB NO. 5856 FIG. 3A

BORING B-4

Surface Elevation: 174.0 ft [±] (City of Portland)

DEPTH, FT	CLASSIFICATION OF MATERIAL	ELEVATION, FT / DEPTH, FT	SAMPLE NO.	BLOW COUNT	COMMENTS AND ADDITIONAL TESTS
0	Sandy SILT, brown, medium stiff, fine-grained sand, 3-in.-thick heavily-rooted zone at surface				
			S-1	1, 3, 4	
5			S-2	2, 3, 4	
6	Silty SAND, brown, loose to medium dense, fine grained	168.0 / 6.0			
			S-3	3, 2, 2	
10	—some silt, brown-gray, medium dense, fine to medium grained below 10 ft		S-4	7, 7, 6	Water added periodically to improve cutting return
			S-5	4, 4, 6	
15			S-6	6, 7, 7	
20			S-7	9, 8, 8	
25	—trace to some silt, scattered subrounded gravel below 25 ft		S-8	6, 7, 7	
			S-9	19, 24, 25	Clean out hole with 3 inch sampler prior to start of infiltration testing. Final sample taken after testing
30			S-10	13, 14, 14	
31.5	(6/6/2016) Groundwater not encountered	142.5 / 31.5			
35					
40					



GRI BORING LOG (LAT/LONG) GRI DATA TEMPLATE.GDT 6/23/16

Logged By: M. Banks	Drilled by: Dan J. Fischer Excavating, Inc.
Date Started: 6/6/16	Coordinates: Not Available
Drilling Method: Solid-Stem Auger Equipment: Buck Rogers 160 Trailer-Mounted Rig Hole Diameter: 4 in.	Hammer Type: Manual Weight: 140 lb Drop: 30 in.
Note: See Legend for Explanation of Symbols	Energy Ratio: Not Available

GRI

BORING B-4

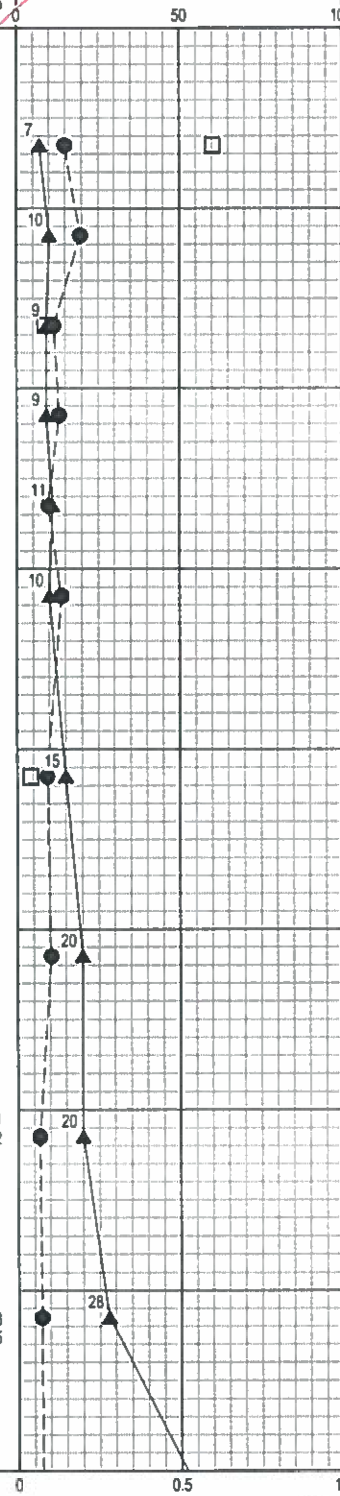
JUNE 2016 JOB NO. 5856 FIG. 4A

BORING B-5

Surface Elevation: 169.0 ft [±] (City of Portland)

DEPTH, FT	CLASSIFICATION OF MATERIAL	ELEVATION, FT / DEPTH, FT	SAMPLE NO.	BLOW COUNT	COMMENTS AND ADDITIONAL TESTS
0–7.5	Sandy SILT, brown mottled rust, medium stiff to stiff, fine-grained sand, 1-in.-thick layer of wood mulch at surface		S-1	4 3 4	
			S-2	5 4 6	
7.5–40	SAND, some silt to silty, brown-gray, loose to medium dense, fine to medium grained	161.5 / 7.5	S-3	4 5 4	
			S-4	4 4 5	Water added periodically to improve cutting return
	—trace to some silt, scattered subrounded gravel below 12.5 ft		S-5	5 5 6	
			S-6	4 5 5	
	—medium dense below 20 ft		S-7	4 7 8	
			S-8	8 9 11	
	—fine to coarse grained below 30 ft		S-9	11 12 8	
			S-10	8 13 15	

▲ BLOWS PER FOOT
● MOISTURE CONTENT, %
□ FINES CONTENT, %
LIQUID LIMIT, %
PLASTIC LIMIT, %



(CONTINUED NEXT PAGE)

◆ TORVANE SHEAR STRENGTH, TSF
■ UNDRAINED SHEAR STRENGTH, TSF

Logged By: M. Banks	Drilled by: Dan J. Fischer Excavating, Inc.
Date Started: 6/6/16	Coordinates: Not Available
Drilling Method: Solid-Stem Auger Equipment: Buck Rogers 160 Trailer-Mounted Rig Hole Diameter: 4 in.	Hammer Type: Manual Weight: 140 lb Drop: 30 in. Energy Ratio: Not Available
Note: See Legend for Explanation of Symbols	

GRI

BORING B-5

JUNE 2016 JOB NO. 5856 FIG. 5A

GRI BORING LOG (LAT/LONG) GRI DATA TEMPLATE.GDT 6/23/16

DEPTH, FT	GRAPHIC LOG	CLASSIFICATION OF MATERIAL Surface Elevation: 169.0 ft [±] (City of Portland)	ELEVATION, FT DEPTH, FT	INSTALLATION	SAMPLE NO.	SAMPLE TYPE	BLOW COUNT	▲ BLOWS PER FOOT ● MOISTURE CONTENT, % □ FINES CONTENT, % LIQUID LIMIT, % PLASTIC LIMIT, % (0 – 50 – 100)	COMMENTS AND ADDITIONAL TESTS
		SAND, trace to some silt, brownish gray, medium dense, fine to coarse grained, scattered subrounded gravel	127.5 41.5		S-11		17 36 20	56	Sampler driven through gravel or cobble at 40 ft
		(6/6/2016) Groundwater not encountered							
45									
50									
55									
60									
65									
70									
75									
80									

0 0.5 1.0

◆ TORVANE SHEAR STRENGTH, TSF
■ UNDRAINED SHEAR STRENGTH, TSF

GRI BORING LOG (LAT/LONG) GRI DATA TEMPLATE.GDT 6/23/16

GRI

BORING B-5

CE 483 – Scope of Work Statement - Fall 2018

Group # _4__

4/4

Names: **1.** John Black
2. Kyle Cadiz
3. Sofia Martinez
4. Leily Mojarab

Project Name: **Dundon Berchtold Hall (Academic Building Design), Portland, OR**
Academic Advisor: Dr. Mehmet Inan

Detailed Thorough	Vague, Incomplete Confusing	Wrong, Missing Item	
✓			Detailed list **and description** of all design items that will be performed and delivered in the CE 484 course.
✓			The extent to which each item will be performed (conceptual design, initial design with sketches, final design with construction drawings, single-line drawings, feasibility study, alternatives analysis, rough cost analysis, detailed cost analysis, etc)
✓			Items that will not be performed in CE 484

August 31, 2018
Revised Nov 5, 2018

U:admin/EGRsec/Mehmet/CE/483(was481)/ ScopeofWorkStatement_Master

CE 483
Fall 2018

Dr. Inan

GR: 4
11/2/18

University of Portland
Dundon-Berchtold Structural Design
Capstone Senior Design Project
SCOPE OF WORK
November 2, 2018

PROJECT UNDERSTANDING

The Dundon-Berchtold Structural Design project is a currently existing, ongoing construction site located at 5000 N Willamette Boulevard in Portland, Oregon. This building will operate at as an academic building for classrooms and faculty offices.

The primary goals of the project are to:

1. Design a structural frame for the future Dundon-Berchtold academic building on the University of Portland campus
2. Ensure the design fits the architect's needs in the most feasible way possible

PROJECT TEAM

The design team will include the following students and faculty from the University of Portland:

- Leily Mojarab
- Sofia Martinez
- John Black
- Kyle Cadiz
- Dr. Mehmet Inan (faculty advisor)

The design team will include the following firms as industrial advisors:

- KPFF Consulting Engineers: Structural engineering industrial advisor (Aaron Wegner)
- Soderstrom Architects: Architectural industrial advisor (Andrew Burke)
- Fortis Construction, Inc.: Contractor industrial advisor (Kevin Kelly)

SCOPE OF WORK

TASK 1: PROJECT ORGANIZATION

Students should be able to provide relevant information, identify issues, and define the objectives in reference to the design project.

1.1 Project Coordination

The industrial and faculty advisors shall coordinate with the students as needed throughout the duration of the project. Coordination will be prompted by the students and conducted via e-mail correspondence and meetings.

1.2 Project Schedule

Students shall develop, maintain, and monitor a project schedule. Schedule updates will be provided as needed.
Task 1.2 Deliverables: A calendar developed in Microsoft Project with milestones and assignment submittal dates

1.3 Progress Memorandums

Students shall prepare and submit progress reports providing a record of tasks that have been completed and future tasks to complete.
Task 1.3 Deliverables: Progress memorandums with updates and future tasks

1.4 Meetings

Students shall schedule, conduct, prepare for, and document meetings with each other, the faculty advisor, and industrial advisors. They will meet with each other at least once a week. They will meet with the faculty advisor at least once a week. They will meet with the industrial advisor on an as-needed basis.
Task 1.4 Deliverables: Meeting agendas and meeting minutes for each meeting

TASK 2: ENGINEERING DESIGN

Based on the results of background analysis of structural properties (such as building material, necessary codes, and desired properties of the academic building), and previous structural analysis (such as reinforced concrete, and steel design) students shall develop a final structural design for the frame of the Dundon-Berchtold academic building. Plans shall be developed in conformance with the City of Portland's CAD standards. The following shall be provided in the final engineering written report:

- Introduction
- Background of the project
- Design approach and evaluation of alternatives
- Discussion and conclusions
- Meeting minutes and meeting agendas
- Drawings
- Calculations
- Progress memorandums
- Team charter
- Misc.

Task 2 Deliverables:

- Written report
- Poster presentation
- Construction drawings
- Virtual structural model

2.1 Conceptual Design

Students will be develop a broad outline of the function and form of the building. This will includes the interactions, experiences, processes and strategies involved with the design of the building.

2.2 Initial Design with Sketches

Students will develop an initial design composing of all necessary sketches with rough calculations to support the sketches.

2.3 Final Design with Construction Drawings

Students will develop a virtual structural model that will be subjected to load testing to determine structural soundness of overall design. Students will also produce structural contract drawings to accompany their design that will include structural framework and connection details.

2.4 Feasibility Study

Students will determine the feasibility of the design through structural analysis, cost analysis, and constructability taking into account the environmental impacts of the design.

2.5 Alternatives Analysis

Students will analyze alternative designs to determine the feasibility of constructing Dundon-Berchtold Hall. Students will consider the cost for construction, the sizing of the rooms as per the request of the University, and the aesthetic appeal of different construction materials. Students will focus their alternative designs between steel, wood, and concrete to determine which material will perform the best for this project.

2.6 Rough Cost Analysis

Students will develop an initial cost analysis with their preliminary design that will comprise of a rough estimate of the cost materials required for their preliminary design.

2.7 Detailed Cost Analysis

Students will develop a final cost analysis with their final design that will comprise of a detailed estimate of the cost of the materials and labor required for their final design.

TASK 4: SCHEDULE

Students will provide a schedule of their work. This schedule will establish the timeframe in which they will analyze alternatives design, develop their conceptual, initial, and final design, and do all necessary analyses for their written report.

Task 4 Deliverables: Schedule mapped out in Microsoft Project

RELATED ITEMS THAT WILL NOT BE PERFORMED OR DELIVERED – in CE 484

The following items will not be included in the student's scope of work:

- Stair design
- Minor construction details, outside of those relevant to the framework of the building
- Chimney framework design
- Non-structural design
- All structural aspects outside of the signature building

Sofia Martinez, Leily Mojarab, Kyle Cadiz, John Black

Microsoft Project

	Task Mode	Task Name	Duration	Start	Finish	Predecessors
1		Work on Scope of Work	6 days	Thu 10/25/18	Thu 11/1/18	
2		Scope of Work Assignment	0 days	Fri 11/2/18	Fri 11/2/18	1
3		Work on Microsoft Project	2 days	Wed 10/24/18	Thu 10/25/18	
4		Microsoft Project Assignment	0 days	Fri 11/2/18	Fri 11/2/18	3
5		Work on Progress Memo	2 days	Sat 10/27/18	Sun 10/28/18	
6		Progress Memorandum	0 days	Fri 11/2/18	Fri 11/2/18	5
7		Work on Progress Memo	2 days	Sat 11/10/18	Sun 11/11/18	
8		Progress Memorandum	0 days	Fri 11/16/18	Fri 11/16/18	7
9		Licensure Site Review Assignment	0 days	Fri 11/16/18	Fri 11/16/18	
10		Group Review of Draft of Report	2 days	Sat 11/17/18	Mon 11/19/18	
11		Draft of Report	0 days	Mon 11/19/1	Mon 11/19/1	
12		Peer Review	0 days	Mon 11/26/1	Mon 11/26/1	
13		Oral Presentation	0 days	Fri 11/30/18	Fri 11/30/18	
14		Final Report and Poster Presentation	0 days	Fri 12/7/18	Fri 12/7/18	11
15		Determine Governmental Constraints	5 days	Mon 1/14/19	Fri 1/18/19	
16		Determine Loads Uniform Across All Alternative Materials	6 days	Mon 1/21/19	Mon 1/28/19	15
17		Alternate 1 Design Start: Concrete	0 days	Tue 1/29/19	Tue 1/29/19	16
18		Alternative 1 Dead loads	6 days	Tue 1/29/19	Tue 2/5/19	17
19		Cost Analysis	6 days	Wed 2/6/19	Wed 2/13/1!	18
20		Raw Calculations	6 days	Thu 2/14/19	Thu 2/21/19	19
21		Alternative 2 Design Start: Steel	0 days	Fri 2/22/19	Fri 2/22/19	20
22		Alternative 2 Dead loads	3 days	Fri 2/22/19	Tue 2/26/19	21
23		Cost Analysis	3 days	Tue 2/26/19	Thu 2/28/19	22
24		Raw Calculations	3 days	Thu 2/28/19	Mon 3/4/19	23
25		Alternate 3 Design Start: Wood	0 days	Mon 3/4/19	Mon 3/4/1	24
26		Alternative 3 Dead loads	3 days	Mon 3/4/19	Wed 3/6/19	25
27		Cost Analysis	3 days	Thu 3/7/19	Mon 3/11/1!	26
28		Raw Calculations	3 days	Tue 3/12/19	Thu 3/14/19	27
29		Choose Final Alternative	0 days	Fri 3/15/19	Fri 3/15/19	28
30		Necessary Calculations	14 days	Fri 3/15/19	Wed 4/3/19	29
31		Virtual Model	14 days	Fri 3/15/19	Wed 4/3/19	29
32		Plan Sheets	14 days	Fri 3/15/19	Wed 4/3/19	29
33		Full Cost Analysis	6 days	Thu 4/4/19	Thu 4/11/19	32
34		Finish Report	20 days	Fri 3/15/19	Thu 4/11/19	29
35		Practice Oral Presentation	2 days	Thu 4/11/19	Fri 4/12/19	34